TheFoodCourt

Software Documentation

Database Systems Course (2018-2019) – Final Project

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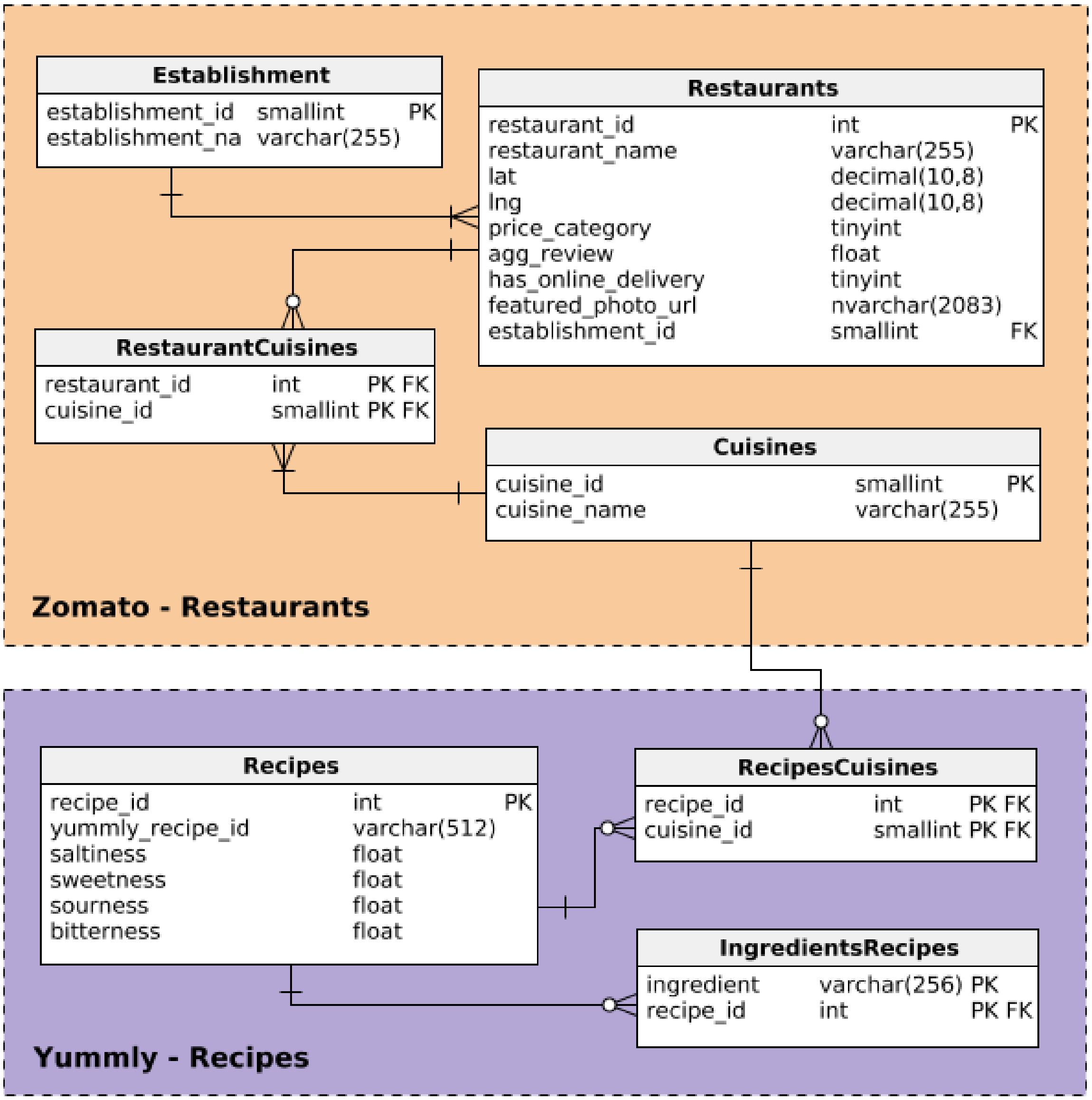
DB Scheme structure

DB Scheme:



For more details, see `CREATE-DB-SCRIPTS.sql`.

Number of rows per table:

Table Name	Establishments	Restaurants	RestaurantsCuisines	Cuisines	Recipes	RecipesCuisines	IngredientsRecipes
# rows	34	5,039	9,274	138	18,734	21,042	164,127

The design choice of our database was inspired by both the APIs we used ("Zomato", "Yummly") and our website design and purpose. As seen in the above image (of the DB scheme), we can split our tables to two parts, one for each API. The two parts are connected through the **Cuisines** table. To make sure that the table values (which are populated from the "Zomato" API) match, during our database population we have created a translation map to translate values of cuisine names between "Zomato" and "Yummly. We will shortly describe each table design choices:

Restaurants: Each row in this table is a projection of values in the "Zomato" API restaurants tables. Only relevant columns for our website were stored in our database. We used "Zomato's" restaurant_id as our key. This enables us to find the restaurant easily (if needed in the future) in the "Zomato" API, without storing another column. The featured photo URL is bound by size to the maximum size of URLs in Microsoft's Internet Explorer.

Establishments: The table is identical to the establishments table in "Zomato" API. Each restaurant has an establishment_id associated with it.

Cuisines: The table is identical to the cuisines table in the "Zomato" API. Each restaurant can have multiple cuisine types, and therefore we use the following table to capture that relation.

RestaurantsCuisines: Used to connect between restaurants and their corresponding cuisines.

Recipes: Each row here is a projection of values in the "Yummly" API recipes tables. Since "Yummly" use an identifier which is a string (the recipe name), which might be long, we have added an AUTO INCREMENT id column as a primary key for each recipe. This is the primary key that is also linked in the following table. This allows us for faster search (small int value instead of long strings) and saves storage space.

IngredientsRecipes: From each "Yummly" recipe, we extract its ingredients and save them up in this table. Since ingredients can appear multiple times in the table, as well as each recipe, the primary key is a tuple of both.

RecipesCuisines: Used to connect between recipes and their cuisines. The cuisine data is stored in each recipe in the "Yummly" API, and we use the translation map mentioned above to match it to the relevant row in the **Cuisines** table.

DB Optimizations Performed

Indexes:

When designing the table and indexes to use, we used one main assumption in our reasoning:

All online queries (queries performed by clients) are `SELECT` queries, and not `INSERT` or `UPDATE` queries.

This key assumption was crucial to our index choice. Since each added index increases insert and update time (due to modification needed after the query to update the index), the assumption above enabled us to add indexes without impacting online performance in terms of query time. We did keep in mind that still, indexes needed to be loaded into memory, thus we still needed to pick our indexes intelligently.

The indexes mentioned below are additional indexes to those created automatically for primary keys. Those are not mentioned here.

- **`flavor_index:`** the index improves query performance for the `` `restaurant_by_taste` `` query (see next chapter). The index is composed of four columns – the exact ones used in the query. Since the query searches up ranges of flavors (e.g. `` `sweetness BETWEEN X AND Y ``) we used a BTREE index.
- **`restaurant_location_index:`** the index improves query performance for all restaurant queries using location filtering. We used a normal BTREE index (and not SPATIAL), since our location filtering for restaurant is simple – a square search around a given location, only needing range querying for the `lat,lng` columns, and not complex geometric queries.
- **`restaurant_review_index:`** the simple index is used to optimize restaurant filtering by user's review averages (the `agg_review` column). Since the query is using comparisons (e.g. `greater than` we used a BTREE for this index as well.
- **`restaurant_price_index:`** similar to the above, but for the `price_category` column

We have also considered a hash index over the **`ingredient`** column in the **`IngredientsRecipes`** table, in order to optimize queries that look up for a specific ingredient value. However, considering the existing BTREE index over this column, the size of the table and the time the queries take without adding the index, we have decided that the index does not justify the added memory usage of it.

Queries

We list below the main query our application uses. Some queries are not mentioned here, but can be viewed in the **sql_queries.py** python script. These queries are small queries with mainly functionality which is transparent to the users. For each query below we show the SQL query code, we describe the query and show sample results.

1: Restaurant Query Wrapper

```sql
SELECT restaurant_name,
       lat,
       lng,
       price_category,
       agg_review,
       has_online_delivery,
       featured_photo_url,
       establishments.establishment_id,
       establishment_name
FROM   establishments,
       (%s) AS source
WHERE  establishments.establishment_id = source.establishment_id
AND    %f <= source.lat
AND    source.lat <= %f
AND    %f <= source.lng
AND    source.lng <= %f
AND    source.price_category = %
AND    source.agg_review >= %s
AND    source.has_online_delivery = %s
AND    source.establishment_id = %s
```

This query is a modular query used to wrap queries that return restaurant values. The input query is added as the **(%s)** with alias **source**. Each **AND** condition is added only if the filtering condition is added. The query adds the establishment name to the restaurant from the **Establishments** table. The modularity is added through the **restaurant_query_builder** function in the **db.py** python file.

Example result:

```
"Dunkin Donuts"  "40.71504167"   "-74.00769167"   "2"     "3"     "0"
        "https://b.zmtcdn.com/data/res_imagery/16758439_CHAIN_212347c0633d3b3c9b006a875bd28882_c.png"  "281"
        "Fast Food"
```

2: Discover new cuisines from cuisine

```
SELECT   cuisinetocuisine.cuisine_id,
         cuisinetocuisine.cuisine_name,
         ( cuisinefreq / cuisine_receipe_count.receipe_weight ) AS match_value
FROM     (
                    SELECT    cuisines.cuisine_id,
                              cuisines.cuisine_name,
                              Count(cuisines.cuisine_id) AS cuisinefreq
                    FROM      (
                                        SELECT    ingredient,
                                                  Count(ingredient) AS maxingredients
                                        FROM      cuisines
                                        LEFT JOIN recipescuisines
                                        ON        cuisines.cuisine_id = recipescuisines.cuisine_id
                                        LEFT JOIN ingredientsrecipes
                                        ON        recipescuisines.recipe_id = ingredientsrecipes.recipe_id
                                        WHERE     cuisines.cuisine_id = %s
                                        GROUP BY  ingredientsrecipes.ingredient) AS commoningredients
                    LEFT JOIN ingredientsrecipes
                    ON        commoningredients.ingredient = ingredientsrecipes.ingredient
                    LEFT JOIN recipescuisines
                    ON        ingredientsrecipes.recipe_id = recipescuisines.recipe_id
                    LEFT JOIN cuisines
                    ON        recipescuisines.cuisine_id = cuisines.cuisine_id
                    WHERE     cuisines.cuisine_id <> %s
                    GROUP BY  cuisines.cuisine_id) AS cuisinetocuisine,
         (
                   SELECT   cuisine_id,
                            count(cuisine_id) AS receipe_weight
                   FROM     recipescuisines
                   GROUP BY cuisine_id) AS cuisine_receipe_count
WHERE    cuisine_receipe_count.cuisine_id = cuisinetocuisine.cuisine_id
ORDER BY match_value DESC limit 3
```

This query, given a cuisine (**`cuisine_id`**), finds new cuisines (i.e. cuisines which are not the input cuisine) which share the greatest number of ingredients for which the cuisines' recipes have. Because some cuisines might have more recipes than other cuisines, we normalize the results with the number of recipes each cuisine has, and calculate it as a **`match_value`**. We return the top three matching cuisine with the highest **`match_value`**. The results of the query are cached in a cache mechanism we implemented in the backend (see last section "Extras" for more details).

Example result, given input cuisine "Greek" (**`cuisine_id = 45`**):

cuisine_id	cuisine_name	match_value
70	Mediterranean	9.4146
147	Moroccan	8.8618
491	Cajun	8.1741

.

3: Query restaurants by ingredients

```
SELECT restaurants.*
FROM   restaurants,
       restaurantscuisines,
       (SELECT recipescuisines.cuisine_id
        FROM   ingredientsrecipes,
               recipescuisines,
               cuisines,
               (SELECT cuisine_id,
                       Count(recipe_id) cuisine_recipe_cnt
                FROM   recipescuisines
                GROUP  BY cuisine_id) AS CuisineRecipesCount
        WHERE  recipescuisines.recipe_id = ingredientsrecipes.recipe_id
               AND ingredientsrecipes.ingredient = '%s'
               AND CuisineRecipesCount.cuisine_id = recipescuisines.cuisine_id
        GROUP  BY recipescuisines.cuisine_id
        ORDER  BY Count(recipescuisines.cuisine_id) / cuisine_recipe_cnt DESC
        LIMIT  3) AS CuisinesByIngredient
WHERE  restaurantscuisines.cuisine_id = CuisinesByIngredient.cuisine_id
       AND restaurants.restaurant_id = restaurantscuisines.restaurant_id
```

Given an ingredient (queried before from the **IngredientsRecipes** table), this query returns restaurants which cuisine types match the top 3 cuisines that are linked to the given input ingredient, adjusted by weight (as the previous query) of the number of recipes for each cuisine. This query is then wrapped with the restaurant query wrapper (query 1).

Example result, given input ingredient “shimeji mushrooms”:

```
"16766735"  "Ginza Japanese Restaurant"   "40.59290833"    "-73.95017222"
      "3"   "3.7" "0"   ""    "21"
```

4: Query restaurants by taste

```
SELECT restaurants.*
FROM   restaurants,
       restaurantscuisines,
       (
              SELECT cuisine_id
              FROM   (
                              SELECT   recipescuisines.cuisine_id,
                                       (Count(recipescuisines.cuisine_id)/cnt) AS weight
                              FROM     recipes,
                                       recipescuisines,
                                       (
                                                SELECT   recipescuisines.cuisine_id,
                                                         Count(recipescuisines.cuisine_id) AS cnt
                                                FROM     recipes,
                                                         recipescuisines
                                                WHERE    recipes.recipe_id = recipescuisines.recipe_id
                                                GROUP BY recipescuisines.cuisine_id ) AS numrecipespercuisine
                              WHERE    saltiness BETWEEN %s
                              AND      sweetness BETWEEN %s
                              AND      sourness BETWEEN %s
                              AND      bitterness BETWEEN %s
                              AND      recipescuisines.recipe_id = recipes.recipe_id
                              AND      recipescuisines.cuisine_id = numrecipespercuisine.cuisine_id
                              GROUP BY recipescuisines.cuisine_id
                              ORDER BY weight DESC) AS matchingtastes
              WHERE  NOT EXISTS
                     (
                            SELECT *
                            FROM   (
                                            SELECT   recipescuisines.cuisine_id,
                                                     (count(recipescuisines.cuisine_id)/cnt) AS weight
                                            FROM     recipes,
                                                     recipescuisines,
                                                     (
                                                              SELECT   recipescuisines.cuisine_id,
                                                                       count(recipescuisines.cuisine_id) AS cnt
                                                              FROM     recipes,
                                                                       recipescuisines
                                                              WHERE    recipes.recipe_id = recipescuisines.recipe_id
                                                              GROUP BY recipescuisines.cuisine_id ) AS numrecipespercuisine
                                            WHERE    saltiness BETWEEN %s
                                            AND      sweetness BETWEEN %s
                                            AND      sourness BETWEEN %s
                                            AND      bitterness BETWEEN %s
                                            AND      recipescuisines.recipe_id = recipes.recipe_id
                                            AND      recipescuisines.cuisine_id = numrecipespercuisine.cuisine_id
                                            GROUP BY recipescuisines.cuisine_id
                                            ORDER BY weight DESC limit 5) AS notmatchingtastes
                            WHERE  matchingtastes.cuisine_id = notmatchingtastes.cuisine_id ) limit 3) AS cuisinesbytaste
WHERE  restaurants.restaurant_id = restaurantscuisines.restaurant_id
AND    restaurantscuisines.cuisine_id = cuisinesbytaste.cuisine_id
```

Similar to the third query, this query returns restaurants as well. However, here the input are the user's flavors preferences (i.e. whether he likes/dislikes salt/sweet/sour/bitter food). This query searches for the cuisines that matches the user's tastes, but also don't match the tastes opposite of the user's. This is done by filtering out such cuisines. All of the values are weighted as well (similar to the above queries) to account for cuisines with high/low number of recipes. Finally, this query can be then wrapped by the restaurant query wrapper.

Example result, given input (dislike salty food, likes sweet food, dislikes sour food, dislikes bitter food):

```
"16761060"  "Bouchon Bakery & Cafe" "40.76841410"     "-73.98270370"    "4"
     "4.3" "0"
     "https://b.zmtcdn.com/data/res_imagery/16761060_RESTAURANT_ce0cc676161
eedd94d28f01a5007a958_c.jpg"  "1"
```

5: Find unique ingredients of cuisine

```
SELECT *
FROM   (
                SELECT   ingredient,
                         Count(ingredient)
                FROM     ingredientsrecipes,
                         recipescuisines
                WHERE    ingredientsrecipes.recipe_id = recipescuisines.recipe_id
                AND      recipescuisines.cuisine_id = %d
                GROUP BY ingredient
                ORDER BY count(ingredient) DESC) AS ingredientsofcuisine
WHERE  NOT EXISTS
       (
              SELECT *
              FROM   (
                              SELECT   ingredient
                              FROM     ingredientsrecipes,
                                       recipescuisines
                              WHERE    ingredientsrecipes.recipe_id = recipescuisines.recipe_id
                              AND      recipescuisines.cuisine_id <> %d
                              GROUP BY ingredient
                              ORDER BY count(ingredient) DESC limit %d) AS ingredientsofothercuisines
              WHERE  ingredientsofothercuisines.ingredient = ingredientsofcuisine.ingredient ) limit 10
```

Given an input cuisine, this query finds the top ingredients that are both common for that cuisine, but are not common in general (thus, are associated with the cuisine). The query, after ordering the ingredients by how they are common for that cuisine, and filtering the most common ingredients of cuisines which are not the input cuisine. If the query with high value of filtering doesn't return a value, the backend server automatically performs a second query with a smaller number of filtering. This query results, similar to query number 2, are cached in the backend server (see "Extras" section).

Example result, given input "Mexican cuisine" (**`cuisine_id = 73`**):

ingredient	**Count(ingredient)**
tomatillos	**137**
refried beans	**103**
cotija cheese	**69**
tequila	**64**
monterey jack cheese	**61**

.

6: Which franchise should I open?

```
SELECT restaurant_name
FROM   (SELECT restaurants.*,
               restaurantscuisines.cuisine_id
        FROM   restaurants,
               restaurantscuisines
        WHERE  EXISTS (SELECT *
                       FROM   (SELECT *
                               FROM   (SELECT restaurant_name
                                       FROM   restaurants
                                       GROUP  BY restaurant_name
                                       HAVING Count(restaurant_name) > 10) AS
                                      Franchises
                               WHERE  NOT EXISTS (SELECT *
                                                  FROM   (SELECT restaurant_name
                                                          FROM   restaurants
                                                          WHERE
                                                 lat BETWEEN %f AND %f
                                                 AND lng BETWEEN %f AND
                                                     %f) AS
                                                         LocationRestaurants
                                                  WHERE
                                      Franchises.restaurant_name =
       LocationRestaurants.restaurant_name))
       AS
       FranchisesNotInLocation
       WHERE  restaurants.restaurant_name =
       FranchisesNotInLocation.restaurant_name)
       AND restaurants.restaurant_id = restaurantscuisines.restaurant_id) AS
       OptionalFranchises
WHERE  NOT EXISTS (SELECT *
                   FROM   (SELECT cuisine_id
                           FROM   restaurants,
                                  restaurantscuisines
                           WHERE  lat BETWEEN %f AND %f
                                  AND lng BETWEEN %f AND %f
                                  AND restaurants.restaurant_id =
                                      restaurantscuisines.restaurant_id
                           GROUP  BY cuisine_id
                           ORDER  BY Count(cuisine_id) DESC
                           LIMIT  15) AS CuisinesInLocation
                   WHERE  CuisinesInLocation.cuisine_id =
                         OptionalFranchises.cuisine_id)
GROUP  BY restaurant_name
```

This unique query, given a location (**lat,lng**) gives suggestion on which franchises should be opened in that location in order to maximize success. First, franchises are defined by restaurants for which there are more 10 branches of. The query searches for franchises that are not existing with a certain L1 distance from the given location (to avoid opening two McDonald's in the same location for example), and then filtering out franchises that cuisine type is not one of the top 15 cuisine types in that location (so the new franchise will give a new value to the location).

Example result, given input "Times Square Location" (**lat: 40.758899, lng: -73.9873197**):

Restaurant_name
Kennedy Fried Chicken
Golden Krust
Taco Bell

.

7: Find common ingredients with a given ingredient

```
SELECT   ingredient,
         Count(ingredient)
FROM     recipes,
         ingredientsrecipes
WHERE    recipes.recipe_id = ingredientsrecipes.recipe_id
AND      EXISTS
         (
                SELECT re.recipe_id
                FROM   recipes            AS re,
                       ingredientsrecipes AS ir
                WHERE  ir.ingredient = %s
                AND    re.recipe_id = ir.recipe_id
                AND    recipes.recipe_id = re.recipe_id)
AND      ingredientsrecipes.ingredient <> %s
GROUP BY ingredient
ORDER BY count(ingredient) DESC limit 10
```

Given an input ingredient, this query finds the ingredients that appear the most in recipes where the input ingredient is used. The query returns the 10 most common ingredients. This allows users who want to make recipes with their favorite ingredient to know which ingredient usually appears with it, so they can stock them up in their homes.

Example result, given input "tequila":

ingredient	Count(ingredient)
lime juice	32
salt	31
lime	25
triple sec	21
olive oil	17
fresh lime juice	13
jalapeno	12
agave nectar	11
limes	11
ice	11

.

Code Structure

Our code is split in to three parts: DB Population scripts, Frontend and Backend. We will describe in short the structure of each part:

DB Population Scripts [Python, MySQL]:

DB Population scripts are simple standalone python scripts. There are two main scripts – one for the "Zomato" API and one for the "Yummly" API. Each script was created to match the services given by the relevant API. The connection to the API is done using GET requests through the `` `requests` `` python library. We use json and sometimes decoding to process the values we get from the API and then `MySQLdb` to store the values in our databases.

Frontend [HTML, CSS, JS]:

TODO – WEB

Backend [Python, Flask, MySQL]:

The backend is comprised from two parts. The first one is our database – a MySQL database on the university servers. The second is comprised from the backend server. Our backend server is made up a few python scripts. The main one being the `server.py` script which has all the "server" functionality (all the Flask functionality). Each query against the database is done through the "db.py" file, which is managed by a class we have created so there is only one cursor working with the server at any given time. All the queries that include user input are protected against invalid inputs, especially SQL injection – either by the cursor exposed functionality of the MySQLdb library, or by checks that we apply when the integration of the user input is done before the query. The SQL queries themselves are stored in another python script – 'sql_queries.py'. We have introduced two special functionalities to the server as well:

1. Caching – some queries are cached. This means that when the query first executes, we store the result in memory, and make it valid for 24 hours. Therefore, if at any time in these 24 hours the same query is requested, we get the value immediately from the memory instead of running it through the database. This allows for much faster execution time, and reduces load on our database. The queries which are cached are chosen carefully, and only queries which have high probability to reoccur are cached. This is done to prevent saving a lot of query results in memory, since this won't be efficient.

2. Logging – we use a logging system to log every request by users and errors. Each exception that occurs during the server run is stored as an error with the exception value and the location where it happened. This is true also for faulty SQL queries. As stated, apart from the errors, we also store every user generated request to the server. This allows later to analyze usage and create statistics of popular (and unpopular) functionalities and more, to improve the website in terms of usability, reach and performance.

API Used

We use two main APIs for our website:

1. “Zomato” https://developers.zomato.com/ - for restaurant data.
2. “Yummly” https://developer.yummly.com/ - for recipe data.

Apart from these APIs, we also use:

1. “MapBox” https://www.mapbox.com/ - to display maps in the website.

External Packages/Libraries

We use the following external packages:

DB Populations:

1. Python:
   a. ‘requests’ – to connect to the web APIs.
   b. ‘MySQLdb’ – to connect to the MySQL database.

Frontend:

TODO – WEB

Backend:

1. Python:
   a. ‘MySQLdb’ – to connect to the MySQL database.
   b. ‘simplejson’ – to process jsons.
   c. ‘logging’ – to implement the logging feature mentioned above.
   d. ‘flask’ – to create the backend server.
   e. ‘datetime’ – to manage the timed cache mentioned above.

General Flow of the App

TODO – WEB

(AND THEN WE WILL CONTINUE WITH THE BACKEND)