TheFoodCourt

Software Documentation

Database Systems Course (2018-2019) – Final Project

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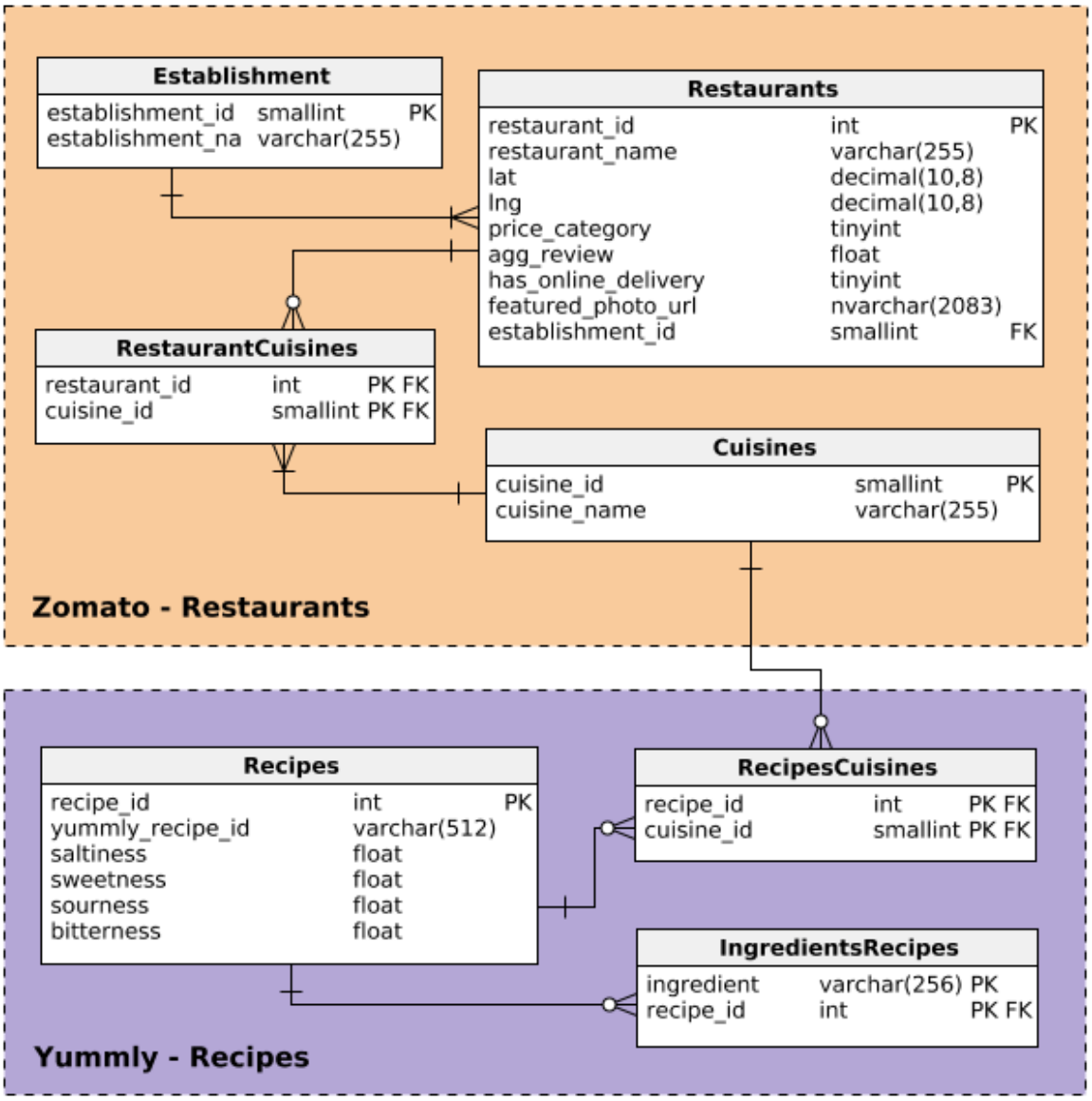
DB Scheme structure

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

TODO: ADD DB CHOICES

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

```
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

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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 5
```

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

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6: Which franchise should I open query?

```
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

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