A.

- Project title: CAU-IIKH
- List of team members: <Class 2 - Team 1>
  20182705 고주형, 20185784 김호성, 20182610 손희승, 20162874 이준협, 20142611 이하람
- Presentation speaker name: 고주형
- Brief project description (summary)
  Efficient kitchen helper that is used for managing a lot of recipes, and planning daily meals like breakfast, lunch or dinner.
  By using our kitchen helper, you can SAVE/DELETE/SEARCH for recipes and manage your meal plans.
  We also put ascii arts inside our program. Pretty UI makes program livelier and fresher. 😊

B.

- How to compile and execute
  ① Change directory to Source Code Package Folder
  ② Open the Solution File with Visual Studio 2019
  ③ Compile (Ctrl-F5) and Execute
- And also, an executable file is in Release Folder so you can directly execute our project file. (How to use executable file is in README.txt)
- System requirement for compilation and execution
  Target OS: Windows 7 / 10
  System Recommendation: Same as Visual Studio 2019 system requirement

C. Description on functionality that was implemented in your SW system:

- Add recipe: Add a new recipe to our Database.
- Delete recipe: Delete existing recipe from our Database.
- Search recipe (Print all recipes):
  Search existing recipe from our Database by recipe name. It is automatically printed in alphabetical order.
  Also, The containing word(Keyword) Search is supported(If you search “pie”, all kinds of recipes whose name includes substring “pie” will be searched. For Example, “apple pie”, “raspberry pie” …)
- Add meal plan: Add new meal plan to our Database.
- Print meal plan: Print all meal plans’ title and breakfast, lunch, dinner’s menu. It is automatically printed in alphabetical order.
- Delete meal plan: Delete existing meal plan from our Database.
- Pretty Ascii art: Maybe it will make user happy and make program fancier.

D. How you implemented (important implementation issues):

- At first, we tried to identify the project given to us before designing. What we were trying to create was IIKH, which needed to create and read a database of recipes and plans. Therefore, we focused on the database when designing the program. Recipes and plans have a database that contains recipe data or plan data. We needed to save the database as a file to load and save, and we chose the file format of the database to be csv. We chose csv format because the delimiter of csv was ','. We thought it would be easy to convert.

  After that, the story came up to here, there were several things we had to do. One is to create the ability to read and write data using the csv file format, the other is to build the internal structure of the data and the database, and the other is to use the data to retrieve, display, or add data within the program. Based on this, we completed the division of roles, and after some communication, integrated the functions and finally completed the program.

➢ Important Issues

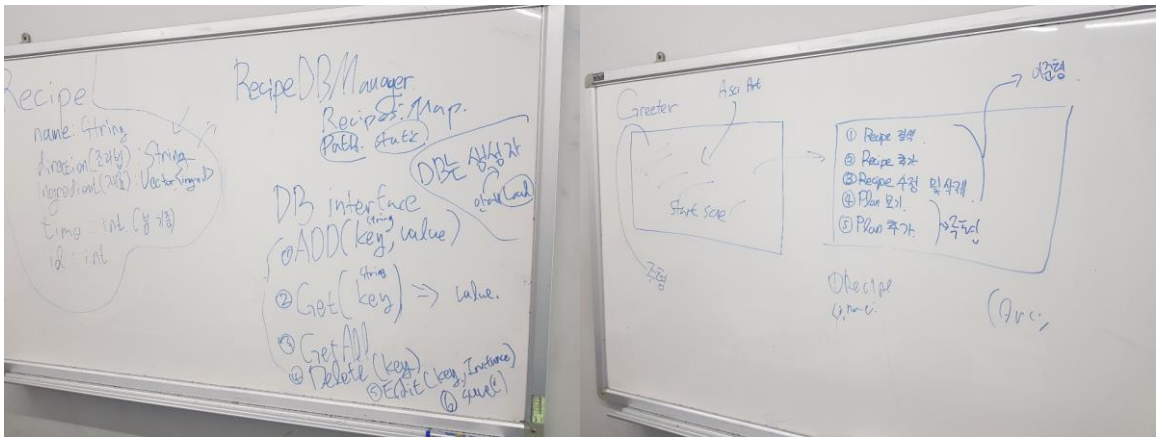
● Issue01: Problem was ambiguous.

Due to ambiguous specification, we had to talked a lot about what is this program, what is our target, what should we implement and how we'll implement this system. Though we had clarified our objective (what we'll implement). The Problems was that the overall program design which is about how we'll implement this program, was chosen by just talking. There was no document or logs about what we talked. Also, after some coding we found out everyone was thinking slightly different design.

By that problem when we are talking about our program, we had many issues such as, Team Member_A thought it is better to make Database Manager for all objects (recipeDBManager, planDBManager, mealDBManaer). But other Team Member_B thought it is better to make integrated Database Manager that can handle all of the objects. By this mismatched when someone coded a Database header, few team members could understand it.

Also, the Plan class was confusing. It was not descripted correctly and specification was made by just talking. For instance, our one team member thought date should be addressed in plan but other team member thought date will be addressed in meal class. Such kinds of situation led our design more complicated and finally became not understandable. So, we had an emergency meeting and unified all of our design. After that we could start programming our given part for each peacefully and confidently.

Below images are meeting logs taken when we were doing Emergency Meeting.

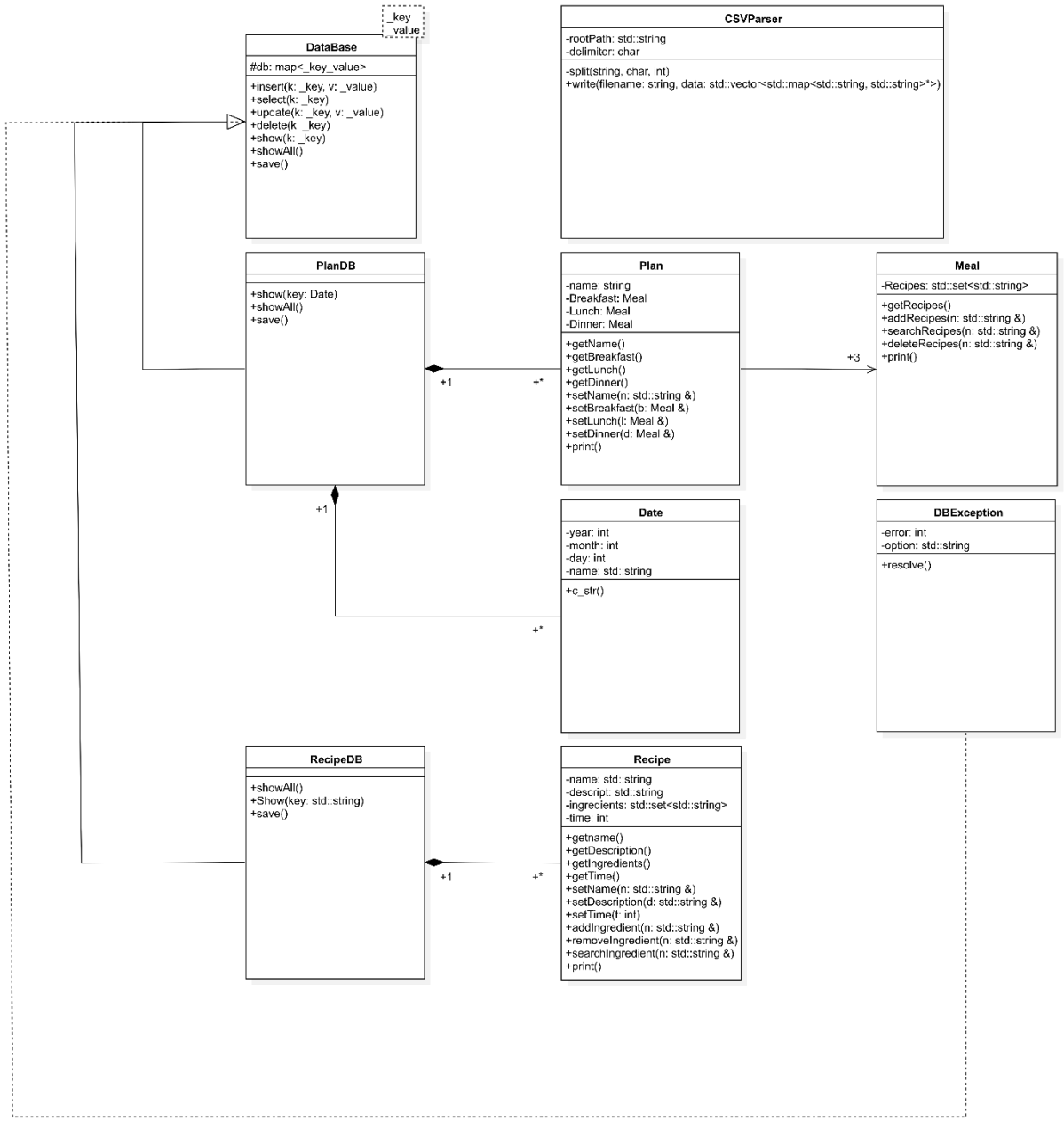


● Issue02: Designing component and giving responsibilities to specific class.

We argued a lot about responsibilities. If a specific class controls every class, the dependency becomes high. This was bad. Bad to debug or understand or extend as we learned.

For example, meal information was needed in everywhere. A Planner had to know meals for daily meal plan, Database Manager should contain every meal for saving, and meal should contain date for searching meal plan by date. After some coding meal class became too huge, and dependent. So, we lowered the dependency of class by giving responsibility to each class and requesting to other class when other class' responsibility is need.

E. The result of SW system design [UML]:



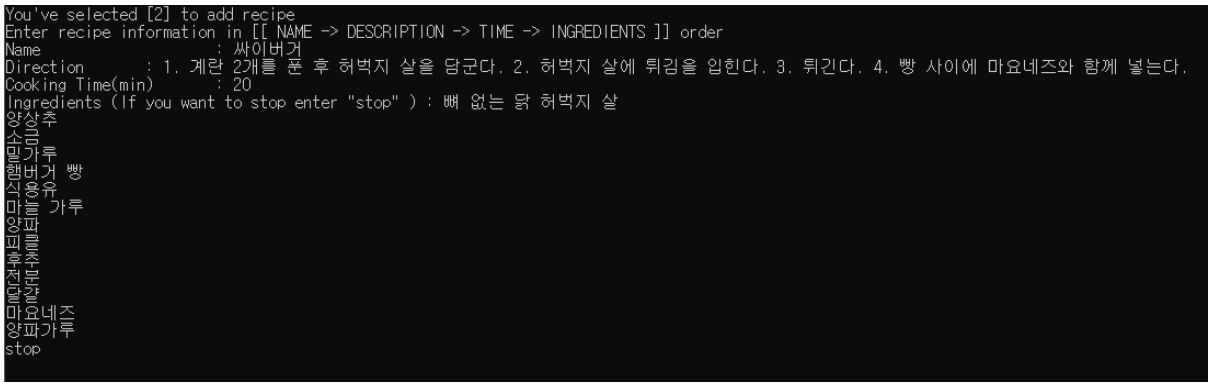
F. Execution results: show real examples of program execution.

(use screen capture)

Show that each function of the SW system is working correctly.

1. Start Scene

2. Adding Thigh Burger Recipe (Menu 2)



3. Searching Thigh Burger Recipe that I just added. (Menu 1)

```
You've selected [1] to search recipe
Search : 싸이
There is 1 matching result for "싸이"
==================================================
==================================================

 >> Recipe Name : 싸이버거
 >> Ingredients :
  - 달걀
  - 마늘 가루
  - 마요네즈
  - 밀가루
  - 뼈 없는 닭 허벅지 살
  - 소금
  - 식용유
  - 양상추
  - 양파
  - 양파가루
  - 전분
  - 피클
  - 햄버거 빵
  - 후추
 >> Cooking Time(min) : 20
 >> Direction(How To Cook)
  - 1. 계란 2개를 푼 후 허벅지 살을 담군다. 2. 허벅지 살에 튀김을 입힌다. 3. 튀긴다. 4. 빵 사이에 마요네즈와 함께 넣는다.
--------------------------------------------------
계속하려면 아무 키나 누르십시오 . . .
```

- You can see all Recipes containing searched word were being printed.

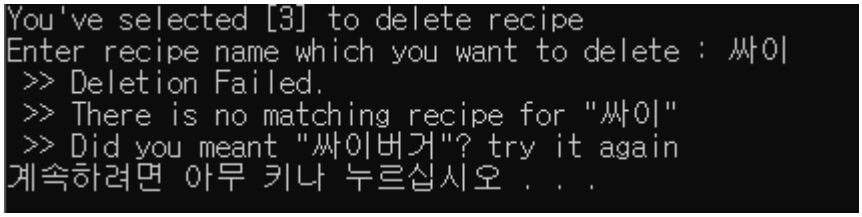
```
You've selected [1] to search recipe
Search : Chicken
There is 5 matching result for "Chicken"
==================================================
==================================================

 >> Recipe Name : Aussie Chicken
 >> Ingredients :
  - 1 cup sliced fresh mushrooms
  - 1 tablespoon dried onion flakes
  - 1 tablespoon vegetable oil
  - 2 cups shredded Colby-Monterey Jack cheese
  - 2 tablespoons chopped fresh parsley
  - 2 teaspoons seasoning salt
  - 4 skinless boneless chicken breast halves - pounded to 1/2 inch thickness
  - 6 slices bacon cut in half
  - ½ cup honey
  - ½ cup prepared yellow mustard
  - ¼ cup light corn syrup
  - ¼ cup mayonnaise
 >> Cooking Time(min) : 25
 >> Direction(How To Cook)
  - Step 1: Rub the chicken breasts with the seasoning salt cover and refrigerate for 30 minutes.    Step 2: Preheat oven to 350 degrees F (175 deg
rees C). Place bacon in a large deep skillet. Cook over medium high heat until crisp. Set aside.    Step 3: In a medium bowl combine the mustard ho
ney corn syrup mayonnaise and dried onion flakes. Remove half of sauce cover and refrigerate to serve later.    Step 4: Heat oil in a large skillet
 over medium heat. Place the breasts in the skillet and saute for 3 to 5 minutes per side or until browned. Remove from skillet and place the breas
ts into a 9x13 inch baking dish. Apply the honey mustard sauce to each breast then layer each breast with mushrooms and bacon. Sprinkle top with sh
redded cheese.    Step 5: Bake in preheated oven for 15 minutes or until cheese is melted and chicken juices run clear. Garnish with parsley and se
rve with the reserved honey mustard sauce.
--------------------------------------------------
 >> Recipe Name : Chicken Enchiladas II
 >> Ingredients :
  - 1 (10.75 ounce) can condensed cream of mushroom soup
  - 1 (4 ounce) can diced green chiles
  - 1 cup shredded Cheddar cheese
  - 1 tablespoon butter
  - 1/2 cup chopped green onions
  - 1/2 cup sour cream
  - 1/2 cups cubed cooked chicken breast meat
  - 1/2 teaspoon garlic powder
  - 1/4 cup milk
  - 6 (12 inch)s flour tortillas
 >> Cooking Time(min) : 30
 >> Direction(How To Cook)
  - Step 1: Preheat oven to 350 degrees F (175 degrees C). Lightly grease a large baking dish.    Step 2: In a medium saucepan over medium heat mel
t the butter and saute the green onion until tender (about 3 to 4 minutes). Add the garlic powder then stir in the green chiles cream of mushroom s
oup and sour cream. Mix well. Reserve 3/4 of this sauce and set aside. To the remaining 1/4 of the sauce in the saucepan add the chicken and 1/2 cu
p of shredded Cheddar cheese. Stir together.    Step 3: Fill each flour tortilla with the chicken mixture and roll up. Place seam side down in the
prepared baking dish.    Step 4: In a small bowl combine the reserved 3/4 of the sauce with the milk. Spoon this mixture over the rolled tortillas
and top with the remaining 1/2 cup of shredded Cheddar cheese. Bake in the preheated oven for 30 to 35 minutes or until cheese is bubbly.
--------------------------------------------------
 >> Recipe Name : Curry Stand Chicken Tikka Masala Sauce
 >> Ingredients :
  - 1 (14 ounce) can tomato sauce
  - 1 cup heavy whipping cream
  - 1 onion
  - 1 tablespoon ground cumin
  - 1 tablespoon vegetable oil
  - 1 tablespoon white sugar
  - 1 teaspoon cayenne pepper
  - 1 teaspoon ground ginger
  - 1 teaspoon salt
  - 1 teaspoon white sugar
```

(This Screen capture is about keyword search)

As you see, by searching “Chicken”, all recipes about chicken were printed out.

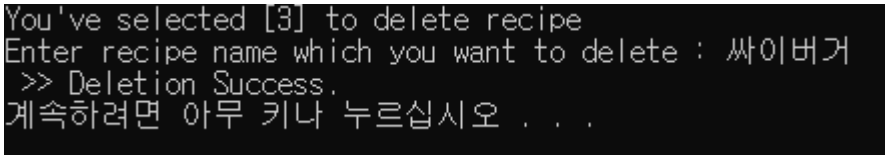
4. See all Recipes including Thigh Burger Recipe that I just added. (Menu 4)

5-1. Trying to Delete Thigh Burger Recipes that I just added. (Menu 3)



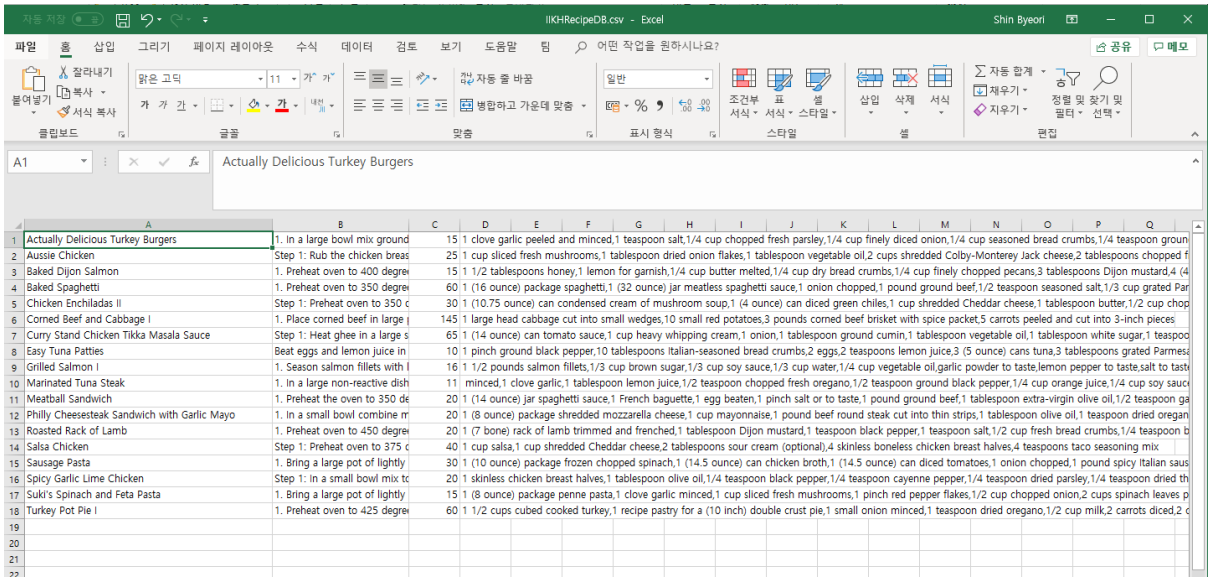
- Deletion Failed because I didn't wrote full name. It gives recommendations.

5-2. Deleting Thigh Burger Recipe that I just added. (Menu 3)



- Deleted Thigh Burger because I wrote full name exactly.

- For convenience, we used CSV format so you can see and edit Recipes in the Excel.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Actually Delicious Turkey Burgers	1. In a large bowl mix ground	15	1 clove garlic peeled and minced,1 teaspoon salt,1/4 cup chopped fresh parsley,1/4 cup finely diced onion,1/4 cup seasoned bread crumbs,1/4 teaspoon groun													
2	Aussie Chicken	Step 1: Rub the chicken breas	25	1 cup sliced fresh mushrooms,1 tablespoon dried onion flakes,1 tablespoon vegetable oil,2 cups shredded Colby-Monterey Jack cheese,2 tablespoons chopped f													
3	Baked Dijon Salmon	1. Preheat oven to 400 degre	15	1 1/2 tablespoons honey,1 lemon for garnish,1/4 cup butter melted,1/4 cup dry bread crumbs,1/4 cup finely chopped pecans,3 tablespoons Dijon mustard,4 (4													
4	Baked Spaghetti	1. Preheat oven to 350 degre	60	1 (16 ounce) package spaghetti,1 (32 ounce) jar meatless spaghetti sauce,1 onion chopped,1 pound ground beef,1/2 teaspoon seasoned salt,1/3 cup grated Par													
5	Chicken Enchiladas II	Step 1: Preheat oven to 350 c	30	1 (10.75 ounce) can condensed cream of mushroom soup,1 (4 ounce) can diced green chiles,1 cup shredded Cheddar cheese,1 tablespoon butter,1/2 cup chop													
6	Corned Beef and Cabbage I	1. Place corned beef in large	145	1 large head cabbage cut into small wedges,10 small red potatoes,3 pounds corned beef brisket with spice packet,5 carrots peeled and cut into 3-inch pieces													
7	Curry Stand Chicken Tikka Masala Sauce	Step 1: Heat ghee in a large s	65	1 (14 ounce) can tomato sauce,1 cup heavy whipping cream,1 onion,1 tablespoon ground cumin,1 tablespoon vegetable oil,1 tablespoon white sugar,1 teaspoo													
8	Easy Tuna Patties	Beat eggs and lemon juice in	10	1 pinch ground black pepper,10 tablespoons Italian-seasoned bread crumbs,2 eggs,2 teaspoons lemon juice,3 (5 ounce) cans tuna,3 tablespoons grated Parmes													
9	Grilled Salmon I	1. Season salmon fillets with l	16	1 1/2 pounds salmon fillets,1/3 cup brown sugar,1/3 cup soy sauce,1/3 cup water,1/4 cup vegetable oil,garlic powder to taste,lemon pepper to taste,salt to taste													
10	Marinated Tuna Steak	1. In a large non-reactive dish	11	minced,1 clove garlic,1 tablespoon lemon juice,1/2 teaspoon chopped fresh oregano,1/2 teaspoon ground black pepper,1/4 cup orange juice,1/4 cup soy sauce													
11	Meatball Sandwich	1. Preheat the oven to 350 de	20	1 (14 ounce) jar spaghetti sauce,1 French baguette,1 egg beaten,1 pinch salt or to taste,1 pound ground beef,1 tablespoon extra-virgin olive oil,1/2 teaspoon ga													
12	Philly Cheesesteak Sandwich with Garlic Mayo	1. In a small bowl combine m	20	1 (8 ounce) package shredded mozzarella cheese,1 cup mayonnaise,1 pound beef round steak cut into thin strips,1 tablespoon olive oil,1 teaspoon dried organ													
13	Roasted Rack of Lamb	1. Preheat oven to 450 degre	20	1 (7 bone) rack of lamb trimmed and frenched,1 tablespoon Dijon mustard,1 teaspoon black pepper,1 teaspoon salt,1/2 cup fresh bread crumbs,1/4 teaspoon b													
14	Salsa Chicken	Step 1: Preheat oven to 375 c	40	1 cup salsa,1 cup shredded Cheddar cheese,2 tablespoons sour cream (optional),4 skinless boneless chicken breast halves,4 teaspoons taco seasoning mix													
15	Sausage Pasta	1. Bring a large pot of lightly	30	1 (10 ounce) package frozen chopped spinach,1 (14.5 ounce) can chicken broth,1 (14.5 ounce) can diced tomatoes,1 onion chopped,1 pound spicy Italian saus													
16	Spicy Garlic Lime Chicken	Step 1: In a small bowl mix to	20	1 skinless chicken breast halves,1 tablespoon olive oil,1/4 teaspoon black pepper,1/4 teaspoon cayenne pepper,1/4 teaspoon dried parsley,1/4 teaspoon dried th													
17	Suki's Spinach and Feta Pasta	1. Bring a large pot of lightly	15	1 (8 ounce) package penne pasta,1 clove garlic minced,1 cup sliced fresh mushrooms,1 pinch red pepper flakes,1/2 cup chopped onion,2 cups spinach leaves p													
18	Turkey Pot Pie I	1. Preheat oven to 425 degre	60	1 1/2 cups cubed cooked turkey,1 recipe pastry for a (10 inch) double crust pie,1 small onion minced,1 teaspoon dried oregano,1/2 cup milk,2 carrots diced,2 c													
19																	
20																	
21																	

6. Setting Meal Plan for 2019/10/11 (Menu 6)

```
You've selected [6] to add plan
Enter plan information in [[ YEAR -> MONTH -> DAY -> DAYNAME -> BREAKFAST -> LUNCH -> DINNER ]] order
Year        : 2019
Month       : 10
Day         : 11
Plan Name       : CAU 101 Anniversary
Breakfast (If you want to stop enter "stop" ) : CAU Burger
Cola
stop
Lunch     (If you want to stop enter "stop" ) : CAU Tous les Jours
Milk
stop
Dinner    (If you want to stop enter "stop" ) : CAU Burger
stop
```

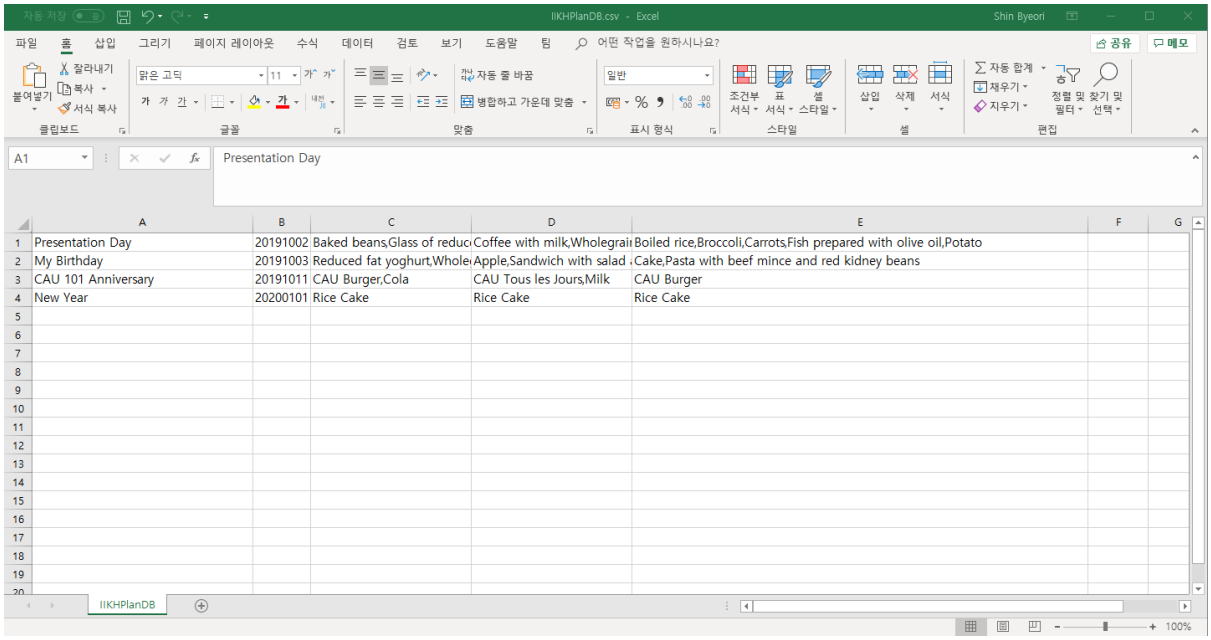
7. You can see all Meal Plans, including Plan you just added (Menu 8)

```
You've selected [8] to view plan
 Plan Name      : Presentation Day
 >> Breakfast
 - Baked beans
 - Glass of reduced milk
 - Tomato
 - Wholegrain toast with polyunsaturated margarine

 >> Lunch
 - Coffee with milk
 - Wholegrain sandwich with roast beef

 >> Dinner
 - Boiled rice
 - Broccoli
 - Carrots
 - Fish prepared with olive oil
 - Potato

--------------------------------------------------
 Plan Name      : My Birthday
 >> Breakfast
 - Reduced fat yoghurt
 - Wholegrain breakfast cereal

 >> Lunch
 - Apple
 - Sandwich with salad and chicken

 >> Dinner
 - Cake
 - Pasta with beef mince and red kidney beans

--------------------------------------------------
 Plan Name      : CAU 101 Anniversary
 >> Breakfast
 - CAU Burger
 - Cola

 >> Lunch
 - CAU Tous les Jours
 - Milk

 >> Dinner
 - CAU Burger

--------------------------------------------------
 Plan Name      : New Year
 >> Breakfast
 - Rice Cake

 >> Lunch
 - Rice Cake

 >> Dinner
 - Rice Cake

--------------------------------------------------
계속하려면 아무 키나 누르십시오 . . .
```

8. You can delete Meal Plan with Date. I deleted CAU 101 Anniversary Plan that I just added. (Menu 7)

```
You've selected [7] to delete plan
Enter date [[ YEAR -> MONTH -> DAY]] order to delete plan
Year         : 2019
Month        : 10
Day          : 11
 >> Deletion Success.
계속하려면 아무 키나 누르십시오 . . .
```

- For convenience, we used CSV format so you can see and edit Plans in the Excel.



	A	B	C	D	E
1	Presentation Day	20191002	Baked beans,Glass of reduc	Coffee with milk,Wholegrai	Boiled rice,Broccoli,Carrots,Fish prepared with olive oil,Potato
2	My Birthday	20191003	Reduced fat yoghurt,Whole	Apple,Sandwich with salad	Cake,Pasta with beef mince and red kidney beans
3	CAU 101 Anniversary	20191011	CAU Burger,Cola	CAU Tous les Jours,Milk	CAU Burger
4	New Year	20200101	Rice Cake	Rice Cake	Rice Cake

9. You can search Plan by Date.

```
You've selected [5] to search plan
Enter date [[ YEAR -> MONTH -> DAY]] order
Year         : 2019
Month        : 10
Day          : 3
 Plan Name       : My Birthday
 >> Breakfast
 - Reduced fat yoghurt
 - Wholegrain breakfast cereal

 >> Lunch
 - Apple
 - Sandwich with salad and chicken

 >> Dinner
 - Cake
 - Pasta with beef mince and red kidney beans

--------------------------------------------------
계속하려면 아무 키나 누르십시오 . . .
```

G. Explain how you applied object-oriented concepts to the development for your project.

1. [Encapsulation] In our OOP class we learned how to hide unnecessary details. We always started from private and when it has to be exposed, we made it public. Plus, we designed the class with their appropriate responsibility. So, our class has only required variables or functions that are related with its responsibility.


```cpp
// stores recipe's name, description, ingredients, time
// and performs action related to recipe and it's member.
class Recipe {
private:
    // Recipe's Name
    std::string name;
    // Recipe's Description
    std::string description;
    // Recipe's Ingredients: it is set of ingredient(we use "string" for ingredient)
    std::set<std::string> ingredients;
    // Recipe's Expected Time it takes to cook.
    int time;
    // ingredientString for saving(Buffer)
    std::string ingredientString;
public:
    // CTOR: name, description, time, ingredients will be initialized
    Recipe(std::string && n, std::string && d, int t, std::vector<std::string> i) :
        name(n), description(d), time(t), ingredients() {
        // insert all ingredient to ingredients set
        for (std::string s : i)
            ingredients.insert(s);
    };

    /* GET */
    // get Recipe name
    const std::string & getName() const { return name; }
    // get Recipe description
    const std::string & getDescription() const { return description; }
    // get Recipe ingredients
    const std::set<std::string> & getIngredients() const { return ingredients; }
    // get Recipe time
    int getTime() const { return time; }

    /* SET */
    // sets Recipe name
    void setName(std::string & n) { name = n; }
    // sets Recipe description
    void setDescription(std::string & d) { description = d; }
    // sets Recipe time
    void setTime(int t) { time = t; }

    /* Functions */
    // insert Recipe ingredient to ingredients set. and returns second stored value
    bool addIngredient(std::string & n) { return ingredients.insert(n).second; }
    // remove Recipe ingredient to ingredients set. and returns second stored value
    bool removeIngredient(std::string & n) { return ingredients.erase(n) == 1; }
    // find if there is ingredient
    bool searchIngredient(std::string & n) { return ingredients.find(n) != ingredients.end(); }
    // make ingredients into single String
    std::string getIngredientsIntoString() {
        for (auto ingredient : ingredients) {
            ingredientString.append(ingredient);
            ingredientString.append("$");
        }

        return ingredientString;
    }
    // print Recipe data
    void print() {
        std::cout << "Recipe Name : " << name << std::endl;
        std::cout << "Ingredients : "<< endl;
        for (std::string s : ingredients) {
            std::cout << " - " << s << std::endl;
```

2. [Inheritance] We looked at the objects relation carefully and made programming more efficient.

For Instance, in case of database manager, many kinds of database managers were needed. We needed Plan Database manager, Meal Database Manager, Recipe Database Manager. Each Database managers was similar to each other and also the code was almost the same but saving format or few functions details were little bit different. So, we made DataBase [parent class] which had all overlapping details of all kinds of Database Managers. Inheriting Database [parent class] traits, making other Database Managers were easier (High Reusability). Also, we could eliminate the same codes.

In addition, with virtual keyword we implemented different details in the Database Managers' functions. That keyword acted like interface and all Database Managers [child class] had implemented mandatory details.

- DataBase [Parent]

```
// stores db map
// and controls entire DB system
class DataBase {
protected:
    std::map<_key, _value> db;

public:
    // static std::string recipeKeys[] = { "index" ,"name","description","time","ingredient0","ingredient1","ingredient2","ingredient3","ingredient4" };

    // insert pair of key and value
    void _insert(_key k, _value v) { db.insert(std::pair<_key, _value>(k, v)); }

    _value & _select(_key k) {
        // if you do not find key (throws exception)
        if (db.find(k) == db.end()) {
            if (IsEqual<_key, std::string>::value) throw DBException(0, k.c_str());
            else if (IsEqual<_key, Date>::value) throw DBException(1, k.c_str());
            else throw DBException(2, k.c_str());
        }

        // if you find key (return value)
        return (*db.find(k)).second;
    }

    // delete pair of key and value, insert new pair of key and value
    void _update(_key k, _value v) {
        db.erase(k);
        db.insert(std::pair<_key, _value>(k, v));
    }

    // delete pair of key and value
    void _delete(_key k) { db.erase(k); }

    // show items with given key
    virtual void _show(_key k) = 0;

    // show all items in DB
    virtual void _showAll() = 0;

    // save DB(items) to local
    virtual void _save() = 0;
};
```

- RecipeDB [Child]

```
// database manager for Recipe
// performs file I/O operations, db items printing
class RecipeDB : public DataBase<std::string, Recipe> {
private:

public:
    // CTOR
    RecipeDB() {
        // msg
        // std::cout << "[디버그] recipe DB 생성" << std::endl;
        // Load File
        std::vector<std::map<std::string, std::string>*> parsedData = CSVParser::instance().read("IIKHRecipeDB.csv");

        for (auto myMap : parsedData) {
            // Construct Recipe Name from csv
            std::string recipeName = myMap->find("name")->second;

            // Construct Plan from csv
            Recipe* recipePtr = new Recipe(
```

- PlanDB [Child]

```
// database manager for Plan(name + 3 meal)
// performs file I/O operations, db items printing
class PlanDB : public DataBase<Date, Plan> {
private:

public:
    // CTOR
    PlanDB() {
        // Load File
        std::vector<std::map<std::string, std::string>*> parsedData = CSVParser::instance().read("IIKHPlanDB.csv");

        for (auto myMap : parsedData) {
            // Construct Date from csv
            Date* datePtr = new Date(strdup(( myMap->find("date")->second.c_str())));

            // Construct Plan from csv
            Plan* planPtr = new Plan(
                // plan name
                std::string(myMap->find("name")->second),
                *datePtr,
                {
                    //아침
                    Meal( CSVParser::instance().split(  myMap->find("breakfast")->second  , "$", -1  ) ),
                    //점심
                    Meal( CSVParser::instance().split(  myMap->find("lunch")->second  , "$", -1  ) ),
```

- Explain what you felt and learned from the project.

[고주형] It was nice to experience object-oriented programming as a team project. It was good chance to think deeply about object-oriented programming and design.

I was team leader so I kept track of project progress. I had to give everyone's work equally to until the program is fully implemented. Also, I had to think in Bottom Up manner. This gave me enlightenment about what is good design and why we use object-oriented programming. I had to rapidly gathered all of our team member's code and I integrated it into our master branch (we used git). When convention was different, I had hard time understanding it. But, unified convention and nicely encapsulated code was easy to use and I didn't confuse much what to use because unneeded functions or variables were forbidden.

[김호성] I've never had a chance to do a project on a team-by-team basis before, and it's been great to be able to do it through this team project, and the process of working together was fun.

[손희승 Coding with others was hard at first but after few days later, it became comfortable. I learned few tips. I know what Github is but didn't use it much. In this project I got chance to know about Git like, how to cooperate using Git, how to invite collaborator. With kind team members, I think I learnt a lot about cooperating.

[이준협] It was interesting to think in various ways because no implementation or details were restricted. And I felt again that teamwork is important.

[이하람] Through this project, I learned and knew about what an Object-oriented programming in the abstract. Also, it was very interesting to discuss together for making the programming because it was the first time for me to learn about c++.

H. Conclusion

Our team project was successful. We argued a lot about what is more good design or what data structure we should use for many models. We learned from each other by talking, arguing and cooperating. We learned how to cooperate in bottom up style code. This kind of experience will be helpful in the future.

Thank You😊