School of Information Technology, Engineering, Mathematics and Physics

CS112: Data Structures and Algorithms
Semester 2, 2022

Assignment 1 – Using Arrays and Structures

Learning Outcome: Demonstrate the usage of various data structures in programming.

Due Date: Friday 30th September 2022 @ 11:55pm (Fiji Standard Time)

Submission: This assignment is to be done in pairs (group of two students). Submit the entire project folder as a zip file via the Moodle Assignment 1 Drop box.

Weight: 10%

Preferred IDE: Microsoft Visual Studio 2019 – Community Edition.

1 Problem Statement

Due to the recent Covid-19 outbreak in Pacific, you have been hired as programmer by your local government to help them with vaccination reports and analysis. The authorities has vaccination data, vaccination registration data for individuals and the vaccination administrative data for individuals in the system. They would like to make a program that would analyze that data to get meaningful insights which would allow the Health Ministry to reach out to the people for vaccination, vaccination drives, reports, and vaccination certificates for travels.

2 Input files

You have been given 3 files to work with `citizens.txt`, `vaccines.txt` and `vaccination.txt`. Download the file from Moodle and save it on your local computer. Depending on the browser you are using, since this is a text file, Moodle might open the file instead of giving you an option of saving it. Hence, to download files, you will need to copy the entire contents of the files after it has been displayed into Moodle and saving it into Notepad with the respective names. The files and its contents are:

1. `citizens.txt` – this file contains the personal details of all users. The file has 7 columns.
   - `c_id` – citizen id is a unique identifier for an individual which identifies a citizen.
   - `fname` – first name of the citizen.
   - `lname` – last name of the citizen.
   - `gender` – gender of the citizen.
   - `age` – age of the user.
   - `phone` – phone contact of the user.
   - `address` – village they belong to.
   - `pre_con` – pre health condition

2. `vaccination.txt` – this file contains the personal details of all users. The file has 7 columns.
   - `c_id` – citizen id is a unique identifier for an individual which identifies a citizen.
   - `num_vac` – this represents the number of vaccines shot the citizen is given. 1 means only first shot, 2 means both vaccines and 3 means both vaccines with booster shot.
   - `V1_code` – a unique identifier for vaccines for first shot/dose which is `vaccine_code in vaccine.txt`.
   - `V1_date` – timestamp in days for simplicity. This means if you have 16005789 for vaccine one short and 16005820 for second vaccine then difference between two vaccine in days is 16005820 – 16005789.
   - `V2_code` – a unique identifier for vaccines for second shot/dose which is `vaccine_code in vaccine.txt`. If second shot is not given, then the value is 0 for V2_code.
   - `V2_date` – timestamp in days for simplicity. This means if you have 16005789 for vaccine one short and 16005820 for second vaccine then difference between two vaccine in days is 16005820 – 16005789. If second shot is not given, then the value is 0000000 for V2_date.
   - `B_code` – a unique identifier for vaccines for Booster shot/dose which is `vaccine_code in vaccine.txt`. If second shot is not given, then the value is 0 for B_code.

- `B_date` – timestamp in days for simplicity. This means if you have 16005789 for vaccine one short and 16005820 for booster vaccine then difference between two vaccine in days is 16005820 – 16005789. If second shot is not given, then the value is 0000000 for B_date.

3. `vaccine.txt` – this file contains the personal details of all users. The file has 7 columns.
   - `vaccine_code` – a unique identifier for different available vaccines.
   - `vaccine_name` – name of the vaccine.
     - Pfizer – given to children below 5 years and age greater than 60 years.
     - Moderna – given to children above 5 years and age less than 17 years.
     - AstraZeneca – given to citizen older than 18 years and less than 59 years.
   - `vaccine_minspace` – this is in days. This shows the minimum number of days citizen has to wait after getting respective vaccine after which second shot can be given.

3 Constraints

- The problem must be solved using Structures and Arrays.
- The program must work with any number of lines in the files, up to 1000. You can create the arrays with a maximum capacity of 1000 to store the file contents.
- Do not edit the input files. The file has arbitrary number of empty lines at the end. This is done intentionally.
- The files `citizens.txt`, `vaccination.txt` and `vaccine.txt` must be placed along with your main.cpp file. That is, in the same location. The files must also be named as `citizens.txt`, `vaccination.txt` and `vaccine.txt` respectively, in small caps in your source code. Do not rename the files to any other name.

4 Requirements

This problem must be solved using structures and arrays. Create the struct for each file. In the driver program, read the files into the respective arrays. The analysis should happen through these arrays.

Your program should do the following:

- Read the data file and store details in Struct.

Create a **menu for the user** that can do the following:

1. `Exit the program` - the program must exit when the user enters 1.

2. `Print the citizens` – this function should print all citizens from `citizen.txt` file. Sample Output:

```
Enter your option (1-5): 2

-------------------------------------------------------------------------
CID      Fname   Lname   Gender          Age    Phone    Address
-------------------------------------------------------------------------
1001    Ray     Dixon     M             4      9364652    Lokia
1002    Bryan   Green     M             65     9579302    Drekena
1003    Justin  Dixon     M             66     9353533    Lokia
1004    Lester  Byrd      M             6      9534695    Nasilai
1005    Santos  Larson    M             15     9093177    Vunuku
1006    Bryan   Cobb      M             11     9905139    Narocivo
1007    Eddie   Watson    M             10     9610408    Nabua
1008    Wesley  Barton    M             27     9801864    Nasigatoka
1009    Victor  Mason     M             50     9855386    Nukutubu
1010    Ellis   Cobb      M             24     9389406    Narocivo
1011    Diana   Ross      F             27     9940148    Vunuku
1012    Amanda  Carter    F             43     9506743    Nasilai
1013    Maria   Edwards   F             53     9798534    Narocivo
1014    Maria   Jenkins   F             34     9352516    Lomanikoro
1015    Louise  Davis     F             55     9812126    Nasilai
1016    Sandra  Sanders   F             29     9369570    Tavuya
1017    Bonnie  Roberts   F             40     9689234    Nukui
1018    Melissa Harris    F             29     9321235    Drekena
1019    Marilyn Parker    F             56     9409221    Nukui
1020    Bonnie  Lopez     F             43     9342939    Nasigatoka

Total users: 20
-------------------------------------------------------------------
```

3. `Print Vaccines` – this function should print all vaccines from `vaccine.txt` file. Sample output.

```
Enter your option (1-5): 3

-----------------------------------------------------
Vaccine Code     Vaccine Name    Vaccine Min Days
-----------------------------------------------------
5001            Pfizer_2.0              15
5002            Moderna1.0              25
5003            AstraZenca              50

Total Vaccines: 3
-----------------------------------------------------
```

4. `Print vaccination data` – this function should print all citizen's vaccination record. (Hint: *you have to use data from all three files*) : Display `Citizen ID | Full Name | Number of Vaccines | Vaccination 1 Name | Vaccination 1 Timestamp | Vaccination 2 Name | Vaccination 2 Timestamp | Booster Name | Booster Timestamp | Vaccination Status` (*Read on different status under 4.1 specification*). You can print blanks for the Vaccination 2 Name and Date, and Booster Name and Date for

partial and fully vaccinated cases. Finally print `Total vaccinated` (at least partial vaccinated as shown in the sample output), percentage of each status for example: `Partial Vaccinated:` 60%, `Fully Vaccinated`: 30%, and `Fully Vaccinated with Booster`: 10%. Sample output.

```
Enter your option (1-5): 4

-------------------------------------------------------------------------------------------------------------------------
C ID    Full Name       #Vac    V1 name         V1 Date         V2 name         V2 Date         Booster name    Booster Date
-------------------------------------------------------------------------------------------------------------------------
1001    Ray Dixon       1       Pfizer_2.0      16793173
1012    Amanda Carter   2       AstraZenca      16793120        AstraZenca      16793195
1002    Bryan Green     1       Pfizer_2.0      16793166
1003    Justin Dixon    2       Pfizer_2.0      16793166        AstraZenca      16793186
1013    Maria Edwards   3       AstraZenca      16793123        AstraZenca      16793201        Pfizer_2.0      16793221
1006    Bryan Cobb      2       Moderna1.0      16793152        Moderna1.0      16793175
1010    Ellis Cobb      1       AstraZenca      16793126
1007    Eddie Watson    2       Moderna1.0      16793150        Moderna1.0      16793177
1009    Victor Mason    1       AstraZenca      16793151
1005    Santos Larson   1       Moderna1.0      16793153
1011    Diana Ross      2       AstraZenca      16793131        AstraZenca      16793171
1004    Lester Byrd     1       Moderna1.0      16793163
1008    Wesley Barton   3       Moderna1.0      16793151        Moderna1.0      16793186        Pfizer_2.0      16793216

Total Vaccinated: 13 out of: 20 citizens: 65.00%
Partial Vaccinated: 46.15%
Fully Vaccinated: 38.46%
Fully Vaccinated with Booster: 15.38%
-------------------------------------------------------------------------------------------------------------------------
```

Explanation:

C ID is citizen ID , #Vac is number of vaccines given to the citizen. Full name comes from Citizen data mapping user using C ID. V1, V2 and Booster name are names for the vaccines given to the citizen. The name comes from Vaccine data mapping the vaccine code. The instance the citizen are partial vaccinated or with 2 shots then vaccination name date dates are blanks for missing ones. Total Vaccinated is number of citizen with at least 1 shot and percentage of total vaccinated is percentage of citizen with at least 1 shot. Partial vaccinated percentage is percentage of vaccinated citizen with 1 shot, Fully vaccinated percentage is percentage of vaccinated citizen with 2 shots and Fully vaccinated with booster is percentage is percentage of vaccinated citizen with 3 shots.

5. `Search citizen using the Citizen ID` - When Ministry of Health needs to give vaccination certificate for an individual citizen, this function should allow the program user to search and print the details of the citizen's vaccination record. Display the `Citizen ID, Full Name, Gender, Age, Phone, Address, Number of Vaccines, Vaccination 1 Name, Vaccination 1 Timestamp, Vaccination 2 Name, Vaccination 2 Timestamp, Booster Name, Booster Timestamp, Vaccination Status`.

```
Enter your option (1-5): 5

Enter the Citizen ID to search: 1003

----------------------
Citizen ID:  1003
Name:    Justin Dixon
Gender:  Male
Age:     66
Phone:   9353533
Address: Lokia

----------------------
Vaccination Detail:
----------------------
Number of Vaccines: 2
Vaccination 1: Pfizer_2.0       Vaccination Date: 16793166
Vaccination 2: Pfizer_2.0       Vaccination Date: 16793186
Vaccination Status: Fully Vaccinated
----------------------
```

Explanation:

User is prompt to enter the citizen ID: example 1003. System prints citizen detail and their vaccination detail. Vaccination Status is based on number of vaccine shots given to the citizen as shown in the following table:

Number of vaccines	Status
1	Partially Vaccinated
2	Fully Vaccinated
3	Fully Vaccinated with Booster

- Except the first menu, all others should be implemented using functions of the main program.
- All inputs must be validated. The program must be able to handle and respond accordingly to any input provided by the user, such as characters or letters instead of numbers.

Your program must conform to the standards of C++ programming. The expectations from this assignment are:

- Proper comments and indentation
- Proper variable and function names
- Correct use of functions, struct and arrays
- Correct program functionality and respective output
- Proper data representation

5 Bonus (2%)

*This functionality is for the **bonus mark to cover up** any marks your group may have lost in Functionality (1-5) under requirements. Attempt this are completing all the Functionality (1-5) under requirements.*
Note: 2% won't be added to 10% to make it 12% but if you scored 8% and completed this functionality then your total will be 8+2=10%. Maximum percentage from the assignment will still be 10% only.

This will be functionality 6 in the menu list.

6. `Print Recommendation` – based on the citizen's vaccination records this function should display the recommendation/comments which includes: `Citizen ID | Full Name | Number of Vaccines | Vaccination Status | Recommendation` (*Read on different recommendation under 5.1 specification*).

```
Enter your option (1-5): 6

-------------------------------------------------------------------------------------------------------
C ID    Full Name       #Vac    Vaccination Status                  Recommendation
-------------------------------------------------------------------------------------------------------
1001    Ray Dixon       1       Partially Vaccinated                5 days left for second shot.
1012    Amanda Carter   2       Fully Vaccinated                    Ready for Booster vaccine: Pfizer.
1002    Bryan Green     1       Partially Vaccinated                Ready for second vaccine: Pfizer.
1003    Justin Dixon    2       Fully Vaccinated                    Fully Vaccinated. Booster is not needed.
1013    Maria Edwards   3       Fully Vaccinated with Booster       Fully Vaccinated with Booster
1006    Bryan Cobb      2       Fully Vaccinated                    2 days left for booster shot.
1010    Ellis Cobb      1       Partially Vaccinated                Ready for second vaccine: AstraZeneca.
1007    Eddie Watson    2       Fully Vaccinated                    Ready for Booster vaccine: Pfizer.
1009    Victor Mason    1       Partially Vaccinated                18 days left for second shot.
1005    Santos Larson   1       Partially Vaccinated                Ready for second vaccine: Moderna.
1011    Diana Ross      2       Fully Vaccinated                    10 days left for booster shot.
1004    Lester Byrd     1       Partially Vaccinated                5 days left for second shot.
1008    Wesley Barton   3       Fully Vaccinated with Booster       Fully Vaccinated with Booster
-------------------------------------------------------------------------------------------------------
```

5.1 Specification

Based on the vaccination record of an individual the recommendation is given for the individual. This recommendation is based on age and number of days after second shot was given. **Only work on the following scenarios and recommendation as shown below:**

Case	Condition 1	Vaccination Status	Recommendation
1	Age below 5 or over 60 years over (including 5 and 60)	Partial vaccinated and Number of days from 1st vaccine is less than `vaccine_minspace`	*N number of* days left for second shot. Eg: 5 days left for second shot. *Hint: N = C - V1_date*
2	Age below 5 or over 60 years over (including 5 and 60)	Partial vaccinated and Number of days from 1st vaccine is more than `vaccine_minspace`	Ready for second vaccine: Pfizer
3	Age below 5 or over 60 years over (including 5 and 60)	Fully Vaccinated	Fully Vaccinated. Booster is not needed.

4	Age above 6 years and below 17 years over (including 6 and 17)	Partial vaccinated and Number of days from 1st vaccine is less than `vaccine_minspace`	N number of days left for second shot. Eg: 5 days left for second shot. *Hint: N = C - V1_date*
5	Age above 6 years and below 17 years over (including 6 and 17)	Partial vaccinated and Number of days from 1st vaccine is more than `vaccine_minspace`	Ready for second vaccine: Moderna
6	Age above 6 years and below 17 years over (including 6 and 17)	Fully Vaccinated and Number of days between 1st and 2nd vaccine is less than `vaccine_minspace`	N number of days left for Booster shot. Eg: 5 days left for booster shot. *Hint: N = V2_date - V1_date*
7	Age above 6 years and below 17 years over (including 6 and 17)	Fully Vaccinated and Number of days between 1st and 2nd vaccine is more `vaccine_minspace`	Ready for Booster vaccine: Pfizer
8	Age above 6 years and below 17 years over (including 6 and 17)	Fully Vaccinated with Booster	Fully Vaccinated with Booster
9	Age above 18 years and below 59 years over (including 18 and 59)	Partial vaccinated and Number of days from 1st vaccine is less than `vaccine_minspace`	N number of days left for Booster shot. Eg: 5 days left for second shot. *Hint: N = V2_date - V1_date*
10	Age above 18 years and below 59 years over (including 18 and 59)	Partial vaccinated and Number of days from 1st vaccine is more than `vaccine_minspace`	Ready for second vaccine: AstraZeneca
11	Age above 18 years and below 59 years over (including 18 and 59)	Fully Vaccinated and Number of days between 1st and 2nd vaccine is less than `vaccine_minspace`	N number of days left for Booster shot. Eg: 5 days left for booster shot. *Hint: N = V2_date - V1_date*
12	Age above 18 years and below 59 years over (including 18 and 59)	Fully Vaccinated and Number of days between 1st and 2nd vaccine is more than `vaccine_minspace`	Ready for Booster vaccine: Pfizer

5.1.1 Keynotes and Hints for Recommendation

For simplicity, the following is applied:

- **C** is current timestamp and for this assignment use which is: **16793183**
- For age below 5 or over 60 years over (including 5 and 60) – only **Pfizer_2.0 vaccine** for first and second shot is given.
- Age above 6 years and below 17 years over (including 6 and 17) - only **Moderna1.0 Vaccine** is given for first and second shot is given.

- Age above 17 years and below 59 years over (including 17 and 59) - only **AstraZeneca vaccine** is given for first and second shot is given.

6 Submission Guidelines

1. Go to the location where your project is saved.
2. **Zip** the **entire** project folder. Do not zip or submit the individual file/files such as main.cpp or any executable file. **You must zip the entire folder**.
3. **Rename** the **zipped file** with the **student IDs** of **both** the group members. Example: **sXXXXXXXX_sXXXXXXXX.zip**. X's represents the ID numbers of the student ID.
4. After renaming, submit the single **zipped file** in the **Assignment 1 Dropbox** on Moodle.
5. After submitting, download your submission on your computer, unzip and open with Microsoft Visual Studio to ensure it opens successfully and you're able to compile and run it.

All submission must be made through the correct dropbox. Do not submit any assignment via email. Late assignments will not be accepted. Please note there will be no due date extension until prior approval has been taken.

LATE ASSIGNMENTS WILL NOT BE ACCEPTED.

Plagiarism

Any kind of plagiarism or cheating like submission of work that is not your own will lead to a ZERO (0) score AND you will be subject to disciplinary action. Discussing is permitted however you must avoid giving your working copy or the final assignment file to anyone. This increases the risk of your assignment being cited as a plagiarized work.

ALL plagiarized assignments will receive a mark of ZERO and will be referred to the Disciplinary Committee.

Assignment Clarification

It is expected that students will seek clarifications regarding this assignment. For any such clarification, you may post a message on Moodle Discussion Forums under the **Assignment 1 Discussions** Topic only. Any message relating to the Assignment placed under a different topic WILL NOT be looked at or answered.

At the same time, please note that you are not allowed to share/discuss your Assignment on these forums. Students must refrain from placing their assignments on the discussion forum. Students found doing this will be referred to the Disciplinary Committee and will also be awarded a mark of ZERO.

Assignment 1 Assessment Rubric

CBOK	Beyond expectation [0% - 49%]	Meet expectation [50% - 75%]	Below Satisfactory [76% - 100%]	Score
Programming	All satisfactory and demonstrate very good programming skills.	I. Able to write a simple code for a well-defined problem II. Use of basic standard programming practices such as commenting, indentation etc. III. computer program produces correct output	I. Code has compile/run/logic errors. Poorly written code. II. Plagiarism III. Poor indentation, hard to read and follow the code IV. Lots of bugs and/or errors V. Program produces unexpected output VI. In appropriate use of variables and parameters. VII. No input validation VIII. Hard coding of data in the program. IX. Program is not well structured.	20

Functions	**Beyond expectation [0% - 49%]**	**Meet expectation [50% - 75%]**	**Below Satisfactory [76% - 100%]**	**Score**
Function 2: Print the Citizens	Function declaration, implementation and call. Function displays correct output. Rubric: I	Function declaration with partial implementation. Rubric: I - III	Only function declaration. Rubric: I - IX	10
Function 3: Print Vaccines	Function declaration, implementation and call. Function displays correct output. Rubric: I	Function declaration with partial implementation. Rubric: I - III	Only function declaration. Rubric: I - IX	10
Function 4: Print Vaccination data	Function declaration, implementation and call. Function displays correct output. Rubric: I	Function declaration with partial implementation. Rubric: I - III	Only function declaration. Rubric: I - IX	30
Function 5: Search citizen using the Citizen ID	Function declaration, implementation and call. Function displays correct output. Rubric: I	Function declaration with partial implementation. Rubric: I - III	Only function declaration. Rubric: I - IX	30
Bonus (2%) – marked separately				
Function 6: Print Recommendation	Function declaration, implementation and call. Function displays correct output. Rubric: I	Function declaration with partial implementation. Rubric: I - III	Only function declaration. Rubric: I - IX	20