Cairo University, Faculty of Computers and Information

FACULTY OF COMPUTERS AND INFROMATION, CAIRO UNIVERSITY

CS112: Programming I
Year 2017-2018

Second Semester

Assignment 3 – Version 1.0

Course Instructors:

Dr. Mohammed Al-Ramly
Dr. Amin Allam

Revision History

Version 1.0	By Dr Mohammed El-Ramly 10 March. 2018	Main Doc

CS111: Fundamentals of CS
Assignment 3 (5 marks + 2 bonus) – Version 1.0

Cairo University, Faculty of Computers and Information

Objectives

This assignment trains students on problem solving using C++ arrays, functions and files.

Introduction

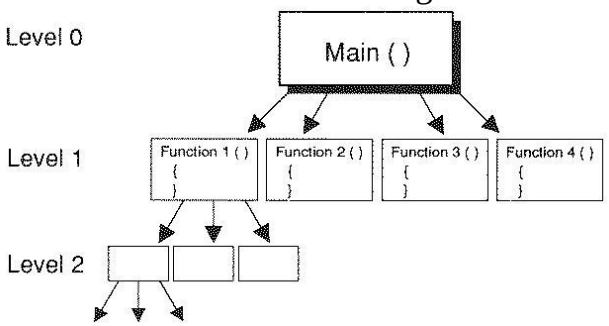
As programs become bigger and complex, it becomes difficult to understand the program and maintain it. To break complexity, some approaches were developed. One of them is **Structured Programming.** In this approach, the program is broken into separate modules or **functions**; each of them does an independent piece of work. Main function calls other function to do the tasks. Functions can call each other also. A function is like a **black box.** After you write it and test, you use it or give it to others to use or put in a library for others to use without knowing the details. It is important is to understand the **input** data (parameters) and the expected **output** (return value).

Also, programs in reality do not depend only on user to input data. Large amounts of data cannot be entered every time. Instead, one must use **files** to store data and retrieve it when needed.

Finally, it is not possible to handle large amounts of similar data in separate variables. They must be stored in groups called **arrays.** An array stores many values of the same type and used indexing to refer to them, e.g. `var [4]` to refer to item 5 (the first item is 0).

You should test your program very well. **The program should use arrays, files and at a separate function for the job it does. You should use C++ arrays, files and functions.**

For each program, you should deliver a **system diagram** showing the **different functions** of the system and **their relation** to each other as shown in the figure below.



Instructions

1. **It is very important to collect course work marks in order to pass easily and get a good grade. من المهم للغاية حسن أداء أعمال السنة لتنجح بسهولة و تحصل على تقدير مرتفع**
2. **These instructions must be followed to get the full marks. يجب اتباع هذه التعليمات بكل دقة**
3. **Deadline for part 1 is Wednesday 28 March 2018 @ 11:59 pm. (Tasks 1 & 2 Group)**
4. **Deadline for part 2 is Tuesday 3 April 2018 @ 11:59 pm. (Task 1 & 2 Complete)**
5. Weight of the assignment is **5 marks** + you can earn **2 bonus** marks.
6. Students will forms teams of three students **from the same lab group** whose IDs are not the same.
7. Please submit **only work that you did yourself**. If you copy work from your friend or book or the net **you will fail the course**. تسليم حلول منقولة من أى مصدر يؤدى إلى الرسوب فى هذا المقرر
لا تغش الحل أو تنقله من أى مصدر و تعالى و اسألنى فى أى شئ لا تفهمه نقل أى جزء و لو صغير من الكود من زميل أو أى مصدر أو إعطاء أى كود و لو قليل لأى زميل يعتبر غشا و يحصل صاحبه على سالب الدرجة.

CS111: Fundamentals of CS
Assignment 3 (5 marks + 2 bonus) – Version 1.0

Cairo University, Faculty of Computers and Information

Task 1 (0.5+0.5 + 0.25 = 1.25 mark) – Individual Task

1. This is to be done by each individual student.
2. Create an account on https://stackoverflow.com with your real name.
3. (0.5) Login and (1) **ask a question** about something unclear to you in C++ or in one of your programs, (2) follow the answers given to your question and (3) find a question in the last month and **write and answer** for it. Do some research to write good answers.
4. (0.25) Upload your solutions for previous assignments in **GitHub.**
5. (0.5) Download Solo Learn App for Andoid mobiles and try all levels in C++ learning up to Functions and Arrays.

Task 2 (1 + 2.75 = 3.75 marks) – Group & Individual Tasks

In this task the team will do one of the following tasks according to the following formula:

Task number = (ID1 + ID2 + ID3) % 4

For example, assume that students 2017013**0**, 2017013**1**, 2017013**5** are in one team because last digits in IDs are different.

Then **0** + **1** + **5** = 6 and 6 % 3 = 0. So, they solve problem 0.

The team will do a **group task** (= 1 mark) together and each team members will do an **individual sub-task** (= 2.75 marks)**.**

The team will develop together a program that opens a file or create a new one, reads textual or numerical data from files into arrays in order to prepare do some functions after that on this data.

Then, each team member will do one of the 3 individual tasks given. They divide the work as follows, the student with the smallest last digit in his ID does sub-task 1, the next does sub-task 2 and so on. **Each task is to be divided into separate functions.** So, in the example above:

Student with ID 2017013**0** does sub-task 1

Student with ID 2017013**1** does sub-task 2

Student with ID 2017013**5** does sub-task 3

Doing the wrong task will result in getting **zero**.

Group must work together to finish this task first and then each member will use the program to complete his individual task **and then they must integrate their work in one program.** Team members **should not use any readymade libraries or functions that perform these tasks.**

CS111: Fundamentals of CS
Assignment 3 (5 marks + 2 bonus) – Version 1.0

Cairo University, Faculty of Computers and Information

Project 0: Text Processor

Group task,

The group will develop a program that opens and existing text file or create a new one. It will also display the content of the current file. The file contains **textual** data. **Use C-Strings** (arrays of characters) and not `string` class.

```
Ahlan ya user ya hbibi.
What do you like to do today?
1- Load an existing file  // Input the name of a file and load its content if exists
2- Create a new file      // Take a file name and create a file with this name.
3- Display file content   // Take the currently loaded file and display it on screen
4- Save the loaded text to the same file again or different one
5- ...
6- ...
E- End
```

To get mark, all students should work together on this program and test it. **And they should integrate all their work in one program.**

Program should do the task and return to the same menu again until the user selects exist.

Individual Sub-task 0.1 (2.75 mark) - Student will implement the following functions:

5- Count the words and the characters in the file

This prints number of words in the file. A word is a sequence of characters not separated by white spaces (space, tab, new line, etc.). It also prints the number of all characters.

6- Search for a word in a file

Take a word from the user and print either: "Word is not found in the file ☹" or "Word is found in the file ☺. Search is case insensitive. Words "Ali", "ali" and "aLI" are the same.

7- Empty file content

This clears the file and erases its content and returns to the main menu.

Individual Sub-task 0.2 (2.75 mark) - Student will implement the following functions:

8- Add more content to the end of the file

This function will allow the user to input more data at the end of the file.

9- Replace a word in the file with another word

This will replace an existing word with another one. Both words are entered by the user.

10- Turn all the content file to upper case

Individual Sub-task 0.3 (2.75 mark) - Student will implement the following functions:

11- Turn all the content file to lower case

12- Add another file to the end of the current file

This function will copy the content of another file to the end of the current file.

13- Encrypt and decrypt the file

This allows applying **ROT13** to cipher the file content or deciphering it. It should display the file content after ciphering or deciphering. ONLY text (small and capital) is ciphered 0or deciphered but other content stays the same.

Bonus Task (2 marks)

Develop a graphics based version with the functions above similar to Windows Notepad.

CS111: Fundamentals of CS
Assignment 3 (5 marks + 2 bonus) – Version 1.0

Cairo University, Faculty of Computers and Information

Project 1: Statistical Tool

The team will develop a tool for performing basic statistical functions and tests.

Group Task (1 mark)

The team together will to develop a program that allows the user to enter data sets and store each one in a separate file. **Data does not have to be ordered.**

```
1- Enter a new data set      // Enter pairs of float values and file name
2- Load a data set           // Take a file name and load data to arrays
3- Display a data set        // Take the currently loaded data set.
4- ...
E- End
```

The file contains **numerical** float data. The program will read the data from the file and load it in an array and offer the user the following menu of options. Program does a task and return to the main menu.

Individual Sub-task 1.1 (2.75 mark) - Student will implement the following functions:

4- Calculate the quartiles of the data set
See details at http://www.alcula.com/calculators/statistics/quartiles/

5- Calculate the Interquartile range
See details at http://www.alcula.com/calculators/statistics/interquartile-range/

6- Calculate the Correlation Coefficient of the data set
See details at http://www.alcula.com/calculators/statistics/correlation-coefficient/

Individual Sub-task 1.2 (2.75 mark) - Student will implement the following functions:

7- Calculate the median value of the data set
Median value divides the data into two equal halves. To find the median, list the values of the data set in numerical order and identify which value appears in the middle of the list.

8- Calculate linear regression coefficients a, b & formula y = ax + b
Simple linear regression is a way to describe a relationship between two variables through an equation of a straight line, called line of best fit, that most closely models this relationship. **Here you will need to enter the name of a file with x, y pairs of values.** See details at http://www.alcula.com/calculators/statistics/linear-regression/

0	4
1	7
3	11
4	12
5	14
6	17
7	16

9- Calculate the mean square error MSE of the linear regression of 8
See details at https://en.wikipedia.org/wiki/Regression_analysis#Linear_regression

Individual Sub-task 1.2 (2.75 mark) - Student will implement the following functions:

10- Calculate the mean and standard deviation of the data set
11- Relative standard deviation
See details at: http://www.fao.org/docrep/W7295E/w7295e08.htm#6.3.3

12- Calculate the mode value of the data set
Mode is the value that appears the most. For example, for data set {30, 45, 12, 45, 80, 38, 45, 30}, 45 is the mode.

Bonus Task (2 marks)

Search for a good plotting library and add to function (8) the ability to draw the x, y data and the linear regression line.

CS111: Fundamentals of CS
Assignment 3 (5 marks + 2 bonus) – Version 1.0

Cairo University, Faculty of Computers and Information

Project 2: Discrete Math Tool

The team will develop a tool for performing discrete math operations.

Group Task (1 mark)

Develop a program that takes allows the user to enter data sets and store each one in a separate file. A set is an unordered collection of objects. The objects in a set are called the elements, or members of the set. Here, a set consists of an arbitrary number of integer values. **A number exists once in the set.** The program allows the user to load two data sets of **integers** in order to perform discrete math operations on them. Program should do the task and return to the same menu again until the user selects exist.

```
Ahlan ya user ya habibi ☺
What do you like to do today?

1-  Enter a new data set // Enter a set of integer values and file name to store them
2-  Load two data sets    // Take two file names and load the data in sets A and B
3-  Display data sets     // Displays the current data sets A and B
4- ......
5- .....
E- End
```

Individual Sub-task 3.1 (2.75 mark) - Student will implement the following functions:

```
4- Union of A, B          // Calculate and display the union
5- Intersection of A, B   // Calculate and display the intersection
6- A - B                  // Calculate and display A – B (items in A not in B)
```

Individual Sub-task 3.2 (2.75 mark) - Student will implement the following functions:

```
7- B - A                  // Calculate and display B - A (items in B not in A)
8- Cartesian product of A and B  // Set of all pairs (a, b) where a ∈ A, b ∈ B
9- Power set of A         // Set of all subsets of A. A = {1,2,3},
                          // P(A) = {Φ,{1},{2},{3},{1,2},{1,3},{2,3},{1,2,3}}
```

Individual Sub-task 3.3 (2.75 mark) - Student will implement the following functions:

```
10- Check if A and B are disjoint     // No item is in A and B at the same time
11- Check if A and B are equal        // A and B have exactly the same items
12- Check if a set is a proper subset of other  // Tell if A ⊂ B or B ⊂ A
```

Bonus Task (1 marks)

Extend the program to work with 3 sets for all the given functions.

CS111: Fundamentals of CS
Assignment 3 (5 marks + 2 bonus) – Version 1.0

Cairo University, Faculty of Computers and Information

How to Prepare and Deliver the Solution

Submitting the Solution


Cairo University
Faculty of Computers and Information

CS251

Software Engineering I

Project Description

2015

Project Team

Dr Mohammad El-Ramly

m.elramly@fci-cu.edu.eg

1. **Team will submit into acadox the following:**

   On Wed 28 March 2018
   - A cpp file with the source code of the group task. Name the file **CS112-2018-2nd –Group-YourID-YourID-A3.cpp**
   - A pdf document including screen shots from GitHub and Stackoverflow.com accounts for every student.

   On Tuesday 4 March 2018
   - A zip file with a pdf document with their names and IDs and list of programs they made. **Load only C++ source code** and any text files to use the program with. Do not load exe files. Name the zip file
     CS112-2018-2nd –Group-YourID-YourID-A3.pdf
     CS112-2018-2nd –Group-YourID-YourID-A3.zip
   - The document should have a cover page similar to this one. (This is for another course)
   - **The source code of the programs in separate folders.**
   - The function decomposition diagram.
   - Screen shots of stackoverflow.com account and your questions and answers.
   - Screen shot of your GitHub account with list of programs you uploaded there.
   - Mobile screen shot of every solo learn account.

2. **Team will submit in paper to the TA following:**
   - A printed version of the pdf document with (1) cover page (2) team names, IDs and list of programs done, (3) function decomposition diagram (4) screen shots of GitHub and stackoverflow.com and (5) Mobile screen shot of every solo learn account.

Program Header

Each program should start with a header explaining what it is and who authored it. It should also have the date.

- لابد أن يحتوى كل برنامج على **تعليقات و إيضاحات كافية** و أن يبدأ بالتعليق التالى:

```
// FCI – Programming 1 – 2018 - Assignment 3
// Program Name:           xxxxxx.cpp
// Last Modification Date: xx/xx/xxxx
// Author1 and ID and Group:     xxxxx xxxxx
// Author2 and ID and Group:     xxxxx xxxxx
// Author3 and ID and Group:     xxxxx xxxxx
// Teaching Assistant:           xxxxx xxxxx
// Purpose:.........
```

CS111: Fundamentals of CS
Assignment 3 (5 marks + 2 bonus) – Version 1.0

Cairo University, Faculty of Computers and Information

Coding Style

The program should follow proper coding style for C++ as shown below.

1- Variable names must be in mixed case starting with lower case.
`line, savingsAccount`
2. The prefix *n* should be used for variables representing a number of objects.
`nPoints, nLines`
3. Iterator variables should be called i, j, k etc.
`for (int i = 0; i < nTables); i++) { : }`
4. The prefix *is* should be used for Boolean variables and methods.
`isSet, isVisible, isFinished, isFound, isOpen`
5. The conditional should be put on a separate line.
`if (isDone) // NOT: if (isDone) statement1;` `  statement1;`
6. Block *layout should be as illustrated in example 1 below (recommended) or example 2

```
while (!done) {
   doSomething();
   done = moreToDo();
}
```

```
while (!done)
{
   doSomething();
   done = moreToDo();
}
```

(Taken from http://geosoft.no/development/cppstyle.html)

Academic Honesty Declaration

Each group should fill this form and submit with report to the TA. يملأ كل فريق هذا القسم و يقدمه مع التقرير للمعيد

Faculty of Computers and Information **جامعة القاهرة – كلية الحاسبات و المعلومات**

Programming 1 – 2018- Assignment 3 **الفرقة الأولى – برمجة الحاسبات ١ – ٢٠١٨ - المسألة ٣**

اسم الطالب.....Name..... **التاريخ** ..... Date ..... **المجموعة**.....Group

اسم الطالب.....Name..... **التاريخ** ..... Date ..... **المجموعة**.....Group

اسم الطالب.....Name..... **التاريخ** ..... Date ..... **المجموعة**.....Group

We give oath that we have fully authored all the programs we submitted for Assignment 3 and we did not copy work from the net, from other colleagues or from any sources.

نقسم بالله العظيم نحن الموقعون أدناه أننا قد قمنا بتنفيذ هذه المسألة Assignment 3 بأنفسنا و لم نغش مطلقا أو ننقل جهد غيرنا للحصول على درجات بغير حق أو نعطى مجهودنا للآخرين بغير حق و الله على ما نقول شهيد (من يتحرج من صيغة القسم لسبب دينى يكتب ما يناسب معتقده)

التوقيع ... ... Signature ..... **التوقيع** ... ... Signature ..... **التوقيع** ... ... Signature .....

CS111: Fundamentals of CS
Assignment 3 (5 marks + 2 bonus) – Version 1.0

Cairo University, Faculty of Computers and Information

Marking Criterion

0.5 mark	For evidence of **posting** a question and **answering** one on stackoverflow.com
0.25 mark	For evidence of uploading pervious code on **GitHub**
0.5 mark	For evidence of using **Solo Learn**
1 marks	(Task 2 – Group part) For correctly loading data from file and handling (1) empty, (2) invalid and (3) wrong data-type files. **And for testing the code of each other.**
2.75 marks	For correctly implementing the required **individual** functions.
-1 mark	If work is not integrated in one program