National University of computer and emerging sciences

Foundation for Advancement of Science and Technology

Programming Fundamentals (CS 1002)

FALL 2021 ASSIGNMENT # 2

Due Date: Sunday, November 14, 2021 (05:00 pm)

Instructions

Please follow the following submission instructions. Failure to submit according to the above format would result in deduction of 10% marks. Submissions on the email will not be accepted.

- Combine all your work (solution folder) in one .zip file. Use proper naming convention for your submission file. Name the .zip file as **SECTION_ROLL-NUM_02.zip** (**e.g. A_21i0412_02.zip**). Your zip file should only contain **.cpp** files, each file should correspond to its question/problem number. Submit .zip file on Google Classroom within the deadline.

Plagiarism: Plagiarism cases will be strictly dealt with. If found plagiarized, both the involved parties will be awarded zero marks in this assignment, all of the remaining assignments, or even an **F grade** in the course. Copying from the internet is the easiest way to get caught!

Deadline: The deadline to submit the assignment is **Sunday, November 14, 2021 (05:00 pm)**. Late submission with marks deduction will be accepted. Correct and timely submission of the assignment is the rresponsibility of every student; hence no relaxation will be given to anyone.

Marking criteria: Your submitted programs will be marked on the following criteria.

Functional requirements	50%
Good user interface (user friendly instructions, layout, presentation)	20%
Proper source code indentation	10%
Programming conventions followed (e.g. variable names,)	20%

Note: Start early so that you can finish it on time

Problem 1: A country has Currency named TIKKA and Currency Notes of amount 750, 350, 200, 85, 15, 3 and 1 TIKKA's. Write a C++ program which:

- accepts amount in TIKKA's as input (integer).
- Pass the user entered TIKKAs to a function which displays total number of Currency Notes of TIKKA 750, 450, 350, 75, 18 and 1.

For example: when user enter a number 1964, the results would be like this.

Currency Note	: Number
750	: 2
450	: 0
350	: 1
75	: 0
18	: 2
1	: 3

Problem 2: Write a C++ program that takes up to 10-digit integer input from user (can be 1 digit, 2 digit, and so on..); passes this to a function which reverses the digits. Finally, the reversed number should be displayed in the main function. For example: when user enters 10-digit like 1234567890 your function will reverse it to 987654321. Be careful for big integer values. [use functions, decision control]

Problem 3: Read about doing multiplication using Karatsuba method (https://en.wikipedia.org/wiki/Karatsuba_algorithm). Write a C++ program which:

- Prompts user to enter two large integer numbers (x, y). Both numbers must be more than 4 digits and less than 10 digits (do input validation, don't use strings). The entered numbers could be negative or positive. For example: 820778 and -58712979 where x is 6-digit positive number and y is 8-digit negative number.
- Make a function called Karatsuba() which takes these two integers and returns the multiplication result using Karatsuba algorithm. You might need to make another helper function called getDigits() which will get an integer as input and returns number of digits of that integer. getDigits() will help you find the value of m and Bm.
- Display result in the main function.

Problem 4: The information about colours is to be stored in bits of a variable called colour. The bit number 0 to 7, each represent 8 colours of a rainbow, i.e. bit 1 represents Blue, 2 represents Green, and so on (see table below). Write a C++ program that asks the user to enter a number and based on this number, an eight lined rainbow (of asterisks *) is to be displayed, such that, if the bit is ON, respective colour is displayed otherwise black line is drawn (not visible).

Bit	1	2	3	4	5	6	7	8
Color	Blue	Green	Cyan	Red	Purple	Yellow	White	Gray

How you will set text color:

```
// C++ program to illustrate coloring
#include <iostream>
#include <windows.h>
using namespace std;

// Driver Code
int main()
{

    SetConsoleTextAttribute(GetStdHandle(STD_OUTPUT_HANDLE), 2);
    cout << "Green Color Text"<<endl;

    SetConsoleTextAttribute(GetStdHandle(STD_OUTPUT_HANDLE), 4);
    cout << "Red Color Text";

    //return to default white color
    SetConsoleTextAttribute(GetStdHandle(STD_OUTPUT_HANDLE), 7);

    return 0;
}
```

More info: http://www.cplusplus.com/forum/beginner/54360/

How you will check whether a bit is ON or OFF:

You will need bit masking, that is, if you want to check whether most significant bit is ON or OFF, you will have to do bitwise AND as follows:

	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
Position	128	64	32	16	8	4	2	1
Number (185)	1	0	1	1	1	0	0	1
	Bitwise AND Operation							
Masking No. (128)	1	0	0	0	0	0	0	0
	Result							
Bitwise AND result (128)	1	0	0	0	0	0	0	0

See help material: Google Class Room -> All PF Course Material -> Reference Material -> Bit Level Operations.html

How to print binary bitstream of an integer:

```
#include <iostream>
#include <bitset>
using namespace std;


int main()
{
    int color = 200;
    bitset<8> color_bits(color);
    cout<<color_bits<<endl;
```

Sample Program Run:

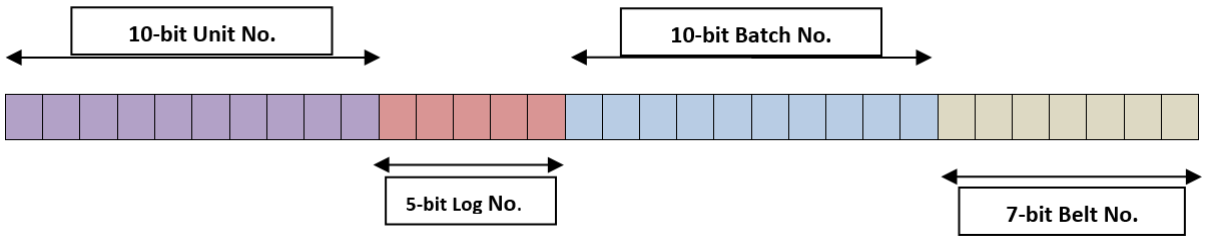
```
Enter any integer : 255
Your entered bitstream is : 11111111
```

```
Enter any integer : 200
Your entered bitstream is : 11001000
```

Problem 5: In a Military database system, IDs of the army personnel are stored in a 32-bit value which is coded as follows:

a. 7-bits Belt number
b. 10-bits Batch number
c. 5-bits Log number
d. 10-bits Unit number

And stored in following format:



Your Task is to write a C++ Program which inputs a four-byte integer ID, and a string Name of the army man. Your Program will separate the Belt number, Batch number, Log number and Unit number and prints the information in the following manner.

```
Enter Name of Army Man:  Abdullah Khan
Enter ID of Army Man:  858993459

Belt number of Abdullah Khan is :      51
Batch number of Abdullah Khan is:     614
Log number  of Abdullah Khan is:      25
Unit number of Abdullah Khan is:     204
```

Problem 6: Write a C++ program to perform 128-bit encryption and decryption using XOR operation. Your program must ask for 128-bit key and plain text then perform encryption and decryption.

```
Enter plain text (corresponding decimal value) : 56552124778965214
Enter key (corresponding decimal value) : 1145598742651225
Your Plain text bitstream is :          00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000011001000111010011101101110001110010111110011010001011110
Your key bitstream is :                 00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000010100010110011001010001110110100011100011001011011100 1
Your Cipher text bitstream is :         00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000011100000010110101111001101110001101000100000110101100111
Your Plain text bitstream is :          00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000011001000111010011101101110001110010111110011010001011110

Process returned 0 (0x0)   execution time : 12.554 s
Press any key to continue.
```

Problem 7: In a computing system (FAST-MAC), a machine level instruction is represented in a 16-bit value, which is further divided into three subparts.

a. 4-bit Operation code (Most Significant bits)
b. 6-bit Left Operand (Middle bits)
c. 6-bit Right Operand (Least significant bits)

And stored in following format:

4-bit opcode	6-bit Left Operand	6-bit Right Operand

Four-bit operation code (**opcode**) of FAST-MAC can define following 16 operations:

Decimal Code	Binary Code	Operation Description
0	0000	Display Value of Right Operand
1	0001	Display Value of Left Operand
2	0010	Take (6-bit) Random input in Right operand
3	0011	Take (6-bit) Random input in Left operand
4	0100	Add Left and Right operand
5	0101	Calculate Subtraction of operands (Subtract Smaller from Larger)
6	0110	Multiply Left and Right operand

7	0111	Calculate division of operands (Divide Larger from smaller)
8	1000	Calculate remainder operands (Larger from smaller)
9	1001	Bitwise OR of Left and Right operand
10	1010	Bitwise AND of Left and Right operand
11	1011	Bitwise XOR of Left and Right operand
12	1100	Complement of Right
13	1101	Complement of Left
14	1110	Left Operand << Right Operand
15	1111	Left Operand >> Right Operand

Write complete C++ program that implements FAST-MAC using appropriate data types and operators. Your program should get a two-byte input from user and then perform the operation as per FAST-MAC. The output to show what operation was performed and on what operand values. The result of the operation should also be displayed.

Problem 8: Write a lottery game application that will generate three random numbers each between 0 and 9. The user should guess three numbers and the program should compare each of the user's guess to the three random and display an appropriate output based on whether they got:

- any one matching
- two matching
- three matching, not in order
- three matching in exact order
- or no matches at all

Problem 9: A library charges a fine for every book returned late. For first 5 days the fine is 50 rupees, for 6-10 days fine is 100 rupees and above 10 days fine is 150 rupees. If you return the book after 30 days your membership will be cancelled. Write a program to accept the number of days the member is late to return the book and display the fine or the appropriate message.

Problem 10: Any character is entered through the keyboard, write a program to determine whether the character entered is a capital letter, a small case letter, a digit or a special symbol.

Problem 11: The colors red, yellow and blue are known as the primary colors because they cannot be made by mixing other colors. When you mix two primary colors, you get a secondary color, as shown here:

- When you mix red and blue, you get purple.
- When you mix red and yellow, you get orange.
- When you mix blue and yellow, you get green.

Write a program that prompts the user to enter the first letter of names of two primary colors to mix. If the user enters anything other than “r,” “b,” or “y,” the program should display an error message. Otherwise, the program should change textcolor to that color displays the name of the secondary color that results. Implement it using if\else structure and then switch structure.

Problem 12: A certain grade of steel is graded according to the following conditions:

- Hardness must be greater than 50
- Carbon content must be less than 0.7
- Tensile strength must be greater than 5600

The grades are as follows:

a. Grade is 10 if all three conditions are met
b. Grade is 9 if conditions (i) and (ii) are met
c. Grade is 8 if conditions (ii) and (iii) are met
d. Grade is 7 if conditions (i) and (iii) are met
e. Grade is 6 if only one condition is met
f. Grade is 5 if none of the conditions are met

Write a program, which will require the user to give values of hardness, carbon content and tensile strength of the steel under consideration and output the grade of the steel.

Problem 13: Write a code that takes two integers as input representing a month and day and prints the season for that month and day. Assume that months are specified as an integer between 1 and 12 (1 for January, 2 for February, and so on) and that the day of the month is a number between 1 and 31. If the date falls between 16/12 and 15/3, you should print "Winter". If the date falls between 16/3 and 15/6, you should print "Spring". If the date falls between 16/6 and 15/9, you should print "Summer". And if the date falls between 16/9 and 15/12, you should print "Fall".

Problem 14: Write a program that displays the following menu:

Geometry Calculator

1. Calculate the Area of a Circle
2. Calculate the Area of a Rectangle
3. Calculate the Area of a Triangle
4. Quit

Enter your choice (1-4):

a. If the user enters 1, the program should ask for the radius of the circle and then display its area. Use the following formula: area = πr2 Use 3.14159 for π and the radius of the circle for r.
b. If the user enters 2, the program should ask for the length and width of the rectangle and then display the rectangle's area. Use the following formula: area = length * width
c. If the user enters 3 the program should ask for the length of the triangle's base and its height, and then display its area. Use the following formula: area = base * height * .5
d. If the user enters 4, the program should end.

Input Validation: Display an error message if the user enters a number outside the range of 1 through 4 when selecting an item from the menu. Do not accept negative values for the circle's radius, the rectangle's length or width, or the triangle's base or height.

Program Design: Use Switch statement for menu. Use functions to calculate areas. Inputs should not be taken in the functions.

Problem 15: Time Calculator: Design a program that asks the user to enter number of seconds, and convert and display equivalent days/hours/minutes/seconds as follows:

a. There are 60 seconds in a minute. If the number of seconds entered by the user is greater than or equal to 60, the program should display the number of minutes in that many seconds.
b. There are 3,600 seconds in an hour. If the number of seconds entered by the user is greater than or equal to 3,600, the program should display the number of hours in that many seconds.
c. There are 86,400 seconds in a day. If the number of seconds entered by the user is greater than or equal to 86,400, the program should display the number of days in that many seconds.

😊 Happy coding: Start you coding now 😊