National University of Computer and Emerging Sciences, LahoreCampus

Course: Programming Fundamentals Course Code: CS1002
Program: BS(Computer Science) Semester: Fall 2023Duration: N/A Total Marks: 100
Due Date: 15/Nov/2023 CLO:
Section: 1K Page(s): 3 Exam: Assignment 6 Roll No.

Instructions:

- *Late submissions will lead to negative marking and submissions after 20hours past the due time will not be accepted.*
- *This is an individual assignment and the solution submitted must be your own.* ● *Any sort of plagiarism will be dealt with seriously and may lead to severe consequences including negative marking.*
- *Submit .cpp files named as XXL-XXXX_Q#X.cpp i.e [your roll number]_[question number].cpp*

Question#1: (10) Take a positive integer from the user and make functions for the following tasks: • Print the count of even and odd digits in it.
• Print the reverse of number

Question#2: (Base Converter) (10) Take a positive integer from the user and make functions for the following tasks: • Convert to Binary
• Convert to Octal

Both these must return the converted values and then you must print them in main function.

Question#3: (Semi Prime) (5)A semi prime is a natural number that is the product of exactly two prime numbers. The twoprimesinthe product may equal each other, so the semi primes include the squares of prime numbers.

For example: 15 is a semi prime number because its factors are 3 and 5, which are prime numbers. Write a function that tells if the given number is semi prime or not.

Question#4: (Duration) (10) Take two times (hours, minutes and seconds and milli-seconds as inputs) as parameters validatethemand if it is a valid time, calculate the difference between the two times. Follow the followingrules:

• The second time has to be greater than first time
• The time value could be between 0 to 23.
• Minute and second could be from 0 to 59.
• Milli-seconds could be from 0 to 999.

Sample I/O:

Input: Start Time: 01:58:47:800
End Time: 15:08:10:200

Output: Duration: 13:10:23:400

Question#5: (Sort & Search) (10) Write a C++ program that takes an array of integers and implements a function to search for a specificinteger in the sorted array using binary search. Use insertion sort to sort the array. Print the sortedarray and whether the target integer was found.

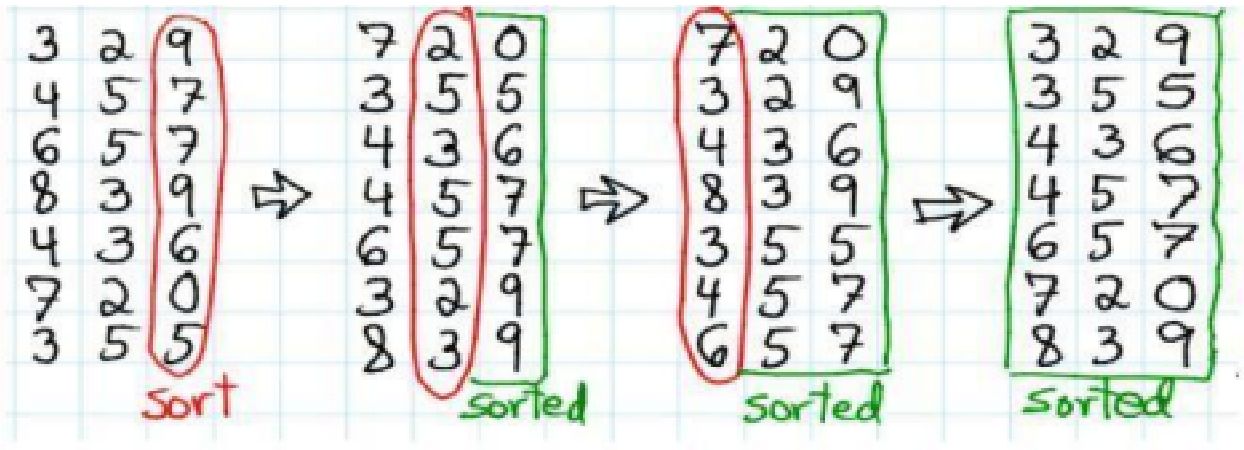
Sample I/O:

Input:
Array: 5 12 3 8 7 1 -99
Target: 3

Output:
Sorted Array: 1 3 5 7 8 12
3 is found in the array.

Problem 6: (Radix Sort) (13) Radix sort is a sorting algorithm, which sorts the keys based on the values of digits in keys. It takesaqueue containing **n** keys to be sorted, where each key consists of **k** number of digits, and there couldbe **m** possible values for each digit **0** through **m-1**. Radix sort uses an array consisting of (**m**) queuesfor sorting of these keys.

For example, if each key contains **k** = 3 digits and each individual digit has **m**=10 possible values0 to 9, then it will use an array consisting of 10 queues 0-9 in the sorting process of consideringall digits one by one as follows.



You have to implement a radix sort function which takes an array and its size and can sort **integer**keys with any value of **n** and **k**.

Question#7: (Computing Leaders) (12) Write a program that takes up to 20 integers (Capacity) as input from the user and prints the numbersinthe same order as entered (make a print function for this). If a user wants to enter less than20numbers,the user shall terminate it with -99.
Further your program should be able to print all the LEADERS in the array. An element is leader ifitisgreater than

all the elements to its right side. And the rightmost element is always a LEADER. Now instead of just printing, store the LEADERS in an array by making a proper function withanarray.After that print LEADERS using the print function.

Sample I/O:

Input: 20 11 12 17 14 16 18 15 19 13 2 -99 **Output:** 20 19 13 2

Question#8: (Finding Median) (10)

You are given an array. Find the median of elements given in the array. If there are odd elements, reportone element otherwise take the average of the middle two values. (You might need to sort thearray, forthat make a function of bubble sort)

Sample I/O:

Input: -6 -4 0 1 2 4 56 512 589
Output: Median = 2

Question#9: (Finding Equilibrium Index) (10)

Write a program that keeps on taking input from the user until the user enters -99 (at maximum100values). Further your program should return an equilibrium index of an array. If no equilibriumindexisfound then your program should return -1.
An index of an array is said to be an equilibrium index if the sum of the elements on its lower indexesisequal to the sum of elements at higher indexes.

Sample Input:

INDEX 0 1 2 3 4 5 6VALUE 7 -1 -5 2 4 -3 0

Sample Output: **3 is an equilibrium index (A[0] + A[1] + A[2] = A[4] + A[5] + A[6] = 1)**

Question#10: (Cartesian Product) (10)

Ask the user to enter two sets (integers). Assume that neither set will contain more than 50elements. Soyou can create arrays of capacity 50 each. Consider the arrays: s1 = {1, 5, 11}, s2 = {3, 0, 5, 9}You need to now perform two tasks:

• Make a function to store the Cartesian product in two separate arrays. cp1 = {1, 1, 1, 1, 5, 5, 5, 5, 11, 11, 11, 11}, cp2 = {3, 0, 5, 9, 3, 0, 5, 9, 3, 0, 5, 9) • Make a function for printing the Cartesian product of s1 and s2. For example, for the sets s1ands2given above, the program should print:

{(1, -3), (1, 0), (1, 5), (1, 9), (5, -3), (5, 0), (5, 5), (5, 9), (11, -3), (11, 0), (11, 5), (11, 9)}