Due Date: 9th Oct 2022
20% penalty for 1 day late
40% penalty for 2 days late
Submission not allowed afterwards

CS2009: Design and Analysis of Algorithms (Fall 2022)
Assignment 2
Total Marks: 100

1. You have a list of 12 elements where each element is either monthly profit or monthly loss of ABC company in that year. Positive value in a list means profit and negative means loss. You need to find out maximum profit that company earned in consecutive months.

   Design brute force algorithm for this in $O(n^2)$ time.

   Design algorithm for this in $O(n)$ time. [5+10 = 15 points]

2. Suppose there are two unsorted sequences of integers i-e A and B. You need to determine if there is an integer "a" in sequence A and an integer "b" in sequence B such that x=a+b. "x" can be taken as an input by user. Output will be "a" and "b" that are making "x". Otherwise output will be "Not possible"

   For example : A = 3124 and B= 5162 and x=10 then no element in A if added to element in B can make 10. So not possible.

   Design algorithm for this problem in $O(nlogn)$ time

   Design algorithm for this problem in $O(n)$ time [5+10 = 15 points]

3. Given a sorted array of distinct integers A[1, ..., n], you want to find out whether there is an index "i" for which A[i] = i.

   For example In [10, 3, 5, 3, 7], A[3] = 3. In [2, 3, 4, 5, 6, 7] there is no such i.

   Design divide and conquer algorithm for this that will take O(logn) time. [10 points]

4. Given an array, you need to shift all zeros to end of array with out changing relative order of other non-zero elements.

   For example If A = [1,0,4,0,0,0,2,0] then output = [1,4,2,0,0,0,0,0]

   Design algorithm for this that takes $O(n)$ time and O(1) space. [20 points]

5. (a) You have studied binary search algorithm to search any number in an array. There is another technique of searching known as Jump Search. Learn about Jump search algorithm from this link https://www.geeksforgeeks.org/jump-search/. Take any input sorted array (atleast of size 8) and search a number present at the end of array using both binary search and Jump search. Show each iteration of both algorithms. Discuss pros and cons of both techniques in different circumstances.

   (b) Learn about how interpolation and exponential search works from this link https://www.geeksforgeeks.org/searching-algorithms/

   Write working of both searching algorithms (interpolation and exponential) in your own words. [15+5 = 20 points]

6. HeapSort is a sorting technique that takes $O(nlogn)$ time. You may search video on youtube as "Heapsort geeks for geeks" to understand working of heap sort. Suppose array A contains 5,2,1,7,3,9,10,8,6,4. Sort it using heap sort along with showing each iteration. [20 points]