

# CS 140: Algorithms(Fall 2016)

## Homework 2

Due time:October 24,2016

Please hand in C/C++ code to **algorithms\_fall2016@outlook.com** with subject: **CS140HW2\_StudentID\_Name** before **24:00, October 24th**. (do check the subject before you send your email).  
Please hand in handwriting in class.

1. [20points] 3 Sum problem. You are given an  $N(N \leq 6000)$  integer number array and a integer number  $k$ , your task is find out 3 numbers in the array, which sum of them is closest to  $k$ . Output the closest sum.(what you need to do is to finish **EX1 3Sum**, hand in code!)
2. [20points] You are given three sequences A, B and C. The length of the three sequences is  $m$ ,  $n$  and  $m+n$  respectively. In other words, the length of C is the sum of the length of A and B. Design an algorithm to check if A and B can be merged into C such that the order of all the letters in A and B is preserved. Example 1: A=aabb, B=cba, C=acabbab, then your algorithm should return true. Example 2: A=aabb, B=cba, C=aaabbbbc, then your algorithm should return false.(what you need to do is to finish **EX2.MergeCheck**, hand in code!)
3. [20points] (CLRS) Stoooge Sort. Professors Howard, Fine, and Howard have proposed the following elegant sorting algorithm:

```
1      STOOGE_SORT(A, i, j)
2          if A[i] > A[j]
3              then exchange A[i] A[j]
4          if i+1 >= j
5              then return
6          k = floor((j-i+1)/3)
7          STOOGE_SORT(A, i, j-k)
8          STOOGE_SORT(A, i+k, j)
9          STOOGE_SORT(A, i, j-k)
```

- a. Argue that, if  $n = \text{length}[A]$ , then  $\text{STOOGE\_SORT}(A, 1, \text{length}[A])$  correctly sorts the input array  $A[1..n]$ .
  - b. Give a recurrence for the worst-case running time of  $\text{STOOGE\_SORT}$  and a tight asymptotic bound on the worst-case running time.
  - c. Compare the worst-case running time of  $\text{STOOGE\_SORT}$  with that of insertion-sort, mergesort, heapsort, and quicksort. Is it better, worse, or about the same as compared to these known algorithms?(handwriting!)
4. [20points] Suppose that you are given a sorted sequence of distinct integers  $A_1, A_2, \dots, A_n$ . Give an  $O(\lg n)$  algorithm to determine whether there exists an  $i$  index such that  $A_i = i$ . For example, in  $-7, -1, 1, 4, 7$   $A_4 = 4$ . In  $2, 3, 4, 5, 6, 7$ , there is no such  $i$ . Please write pseudo-code and analysis it's complexity.(handwriting!)
  5. [20points] You are given two sorted lists of size  $m$  and  $n$ . Give an  $O(\lg m + \lg n)$  time algorithm for computing the  $k$ -th smallest element in the union of the two lists. Please write down your algorithm and analysis it's complexity.(handwriting!)