

CS 5800 – Assignment 2 – online submission – Feb 10, 2020 6 PM PST

1. Missing Number (30 pts.)

An array of n elements is given. It contains all integers from 1 to $n+1$ except one.

- (A) Provide the best possible algorithm to find the missing integer, if the array is sorted. Provide the running time of the algorithm.
- (B) Provide the best possible algorithm to find the missing integer, if the array is *not* sorted. Provide the running time of the algorithm.

2. Dancing Array (30 pts.)

Write an **efficient** algorithm that rearranges an array A containing N elements such that all the negative elements precede all the non-negative elements in the array. Your algorithm should be **in-place** meaning you cannot use any external space. Provide the **running time** of your algorithm. Please note the output array need not be sorted.

For eg: $A = \{1, -3, 0, -2, 7, 0\}$,

One valid output could be: $A = \{-2, -3, 0, 1, 7, 0\}$

3. Fancy MergeSort (40 pts.)

Let us assume we are given an almost sorted array A of length n where there exists a constant K such that whenever two values $A[i]$ and $A[j]$ are in wrong sorting order, $|j - i| \leq k$. Given such an array A as input to the **MergeSort** function:

- (A) How would you modify the **Merge** function to make it run in **$O(1)$** time.
- (B) Re-write the recurrence relation $T(n)$ for the complete **MergeSort** function and solve it to determine the running time in θ notation.