Spring 2023

CSE 317: Design and Analysis of Algorithms, Quiz - 1

Wednesday, February 8, 2023. Total marks: 10 point, Duration: 15 minutes.

Name: _____, Student ID: _____

1. (10 points) Consider two sets of integers A and B (each of size n). Neither A nor B contains duplicates however, they may share some values, i.e., $A \cap B$ is not necessarily empty. We want to compute the difference of these two sets: $A \setminus B$. Design an algorithm that guarantees $O(n \log n)$ worst-case time.

   [Remember: $A \setminus B = \{x : x \in A \text{ and } x \notin B\}$.]

Solution:

Algorithm: SETMINUS

Input: Two sets A and B (each of size n)

Output: The set difference i.e., $A \setminus B$.

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1. C = {}                                   /* C is an empty set */
2. B' = MERGESORT(B)                        /* or using any other sorting algorithm */
3. for x ∈ A                                /* run the following lines for each element in the set A */
4.     if x ∉ B'                            /* using BINARYSEARCH algorithm */
5.         C = C ∪ {x}                      /* add the element x in C */
6. return C                                 /* the set C now contains A \ B */
```

Time complexity: line 2 with sorting takes $O(n \log n)$ time, the for loop on line 3 runs n times (size of set B) and each call to BINARYSEARCH takes $O(\log n)$ time so time complexity of SETMINUS is $O(n \log n)$.