CSCI2100: Special Exercise Set 5

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Problem 1. Let S_1 and S_2 be two sets of integers (they are not necessarily disjoint). We know that $|S_1| = |S_2| = n$ (i.e., each set has n integers). Design an algorithm to report the *distinct* integers in $S_1 \cup S_2$ using $O(n \log n)$ time. For example, if $S_1 = \{1, 5, 6, 9, 10\}$ and $S_2 = \{5, 7, 10, 13, 15\}$, you should output: 1, 5, 6, 7, 9, 10, 13, 15.

Problem 2. Same problem as above. However, this time we assume that S_1 and S_2 have been sorted, i.e., each set is given in an array where its elements are in ascending order. Give an algorithm that runs in $O(n)$ time.

Problem 3. Let S_1 and S_2 be two sets of integers (they are not necessarily disjoint). We know that $|S_1| = |S_2| = n$ (i.e., each set has n integers). Each set is given in array where its elements are in ascending order. Design an algorithm to report $S_1 \cap S_2$ in $O(n)$ time. For example, if $S_1 = \{1, 5, 6, 9, 10\}$ and $S_2 = \{5, 7, 10, 13, 15\}$, you should output: 5, 10.

Problem 4. Consider the array $A = (5, 9, 3, 10, 26, 37, 14, 12)$. Suppose that we sort Q by the quick sort algorithm. What is the probability that the algorithm compares the numbers 3 and 37?

Problem 5. Let A be an array of 6 integers as follows: (8, 3, 4, 1, 7, 10). Suppose that we use counting sort to sort the array, knowing that all the integers are in the domain from 1 to 10. Recall that the algorithm (as described in the class) generates an array B where each element is either 0 or 1. Give the content of B.