CSCI2100: Special Exercise Set 7

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Problem 1. Let $S = \{75, 123, 65, 9, 23, 67, 32, 12, 93\}$. Consider a hash function $h(k) = 1 + ((2k + 17) \mod m)$, where m = 5. Show the resulting hash table. Also, explain how to use the hash table to answer a dictionary search query with value 34.

Problem 2. Let S_1 and S_2 be two sets of integers, such that $|S_1| = |S_2| = n$. Give an algorithm to report all the integers in $S_1 \cap S_2$ in O(n) expected time.

Problem 3. Let S_1 and S_2 be two sets of integers, such that $|S_1| = |S_2| = n$. All the integers are obtained from the domain [1, 20n]. Give an algorithm to report all the integers in $S_1 \cap S_2$ in O(n) worst-case time. (Hint: counting sort).

Problem 4. Let S be a perhaps multi-set of n integers. Give an algorithm to determine whether S has two identical integers. Your algorithm should terminate in O(n) expected time.

Problem 5. Let S be a perhaps multi-set of n integers. Give an algorithm to determine whether S has k identical integers. Your algorithm should terminate in O(n) expected time, regardless of k. For example, suppose that $S = \{75, 123, 65, 75, 9, 9, 32, 9, 93\}$. Then the answer is yes if $k \leq 3$, but no if $k \geq 4$.