

## 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  $h(k) = 1 + ((2k + 17) \bmod m)$ , 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  $k \geq 4$ .