## COMP3506/7505: Special Exercise Set 6

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**Problem 1.** Consider the algorithm for the "stack-with-array" problem, namely, the algorithm that implements a stack as a dynamic array. Suppose we perform 30 pushes, followed by 20 pops, and then by another 20 pushes. What is the length of the array? Remember that the length of the array refers to the specified length when the array is created; it does not mean the number of elements stored in the array.

**Problem 2.** 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 3.** 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 4.** 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.

**Problem 5.** 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 6.** 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  $k \geq 4$ .