## CSCI2100: Special Exercise Set 7

Prepared by Yufei Tao

Problem 1. Let $S=\{75,123,65,9,23,67,32,12,93\}$. Consider a hash function $h(k)=1+((2 k+$ $17) \bmod m$ ), 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 $\left|S_{1}\right|=\left|S_{2}\right|=n$. 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 $\left|S_{1}\right|=\left|S_{2}\right|=n$. 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 $k \geq 4$.

