Weekly Assignment 12

December4, 2019

Exercise 1. *Weight: 15%*

Suppose that a dynamic set S is represented by a direct-address table T of length m. Describe a procedure that finds the maximum element of S. What is the worst-case performance of your procedure?

Exercise 2. *Weight: 10%*

You have a universe of keys consisting of 30 numbers $\{0, 1, \ldots, 29\}$ and a hash table of size 10 that uses chaining. Which hash-function is better, $h_1(k) = k \bmod 10$, or $h_2(k) = \lfloor k/10 \rfloor$? Motivate your answer.

Exercise 3. *Weight: 15%*

Demonstrate what happens when we insert the keys 12, 44, 13, 88, 23, 94, 11, 39, 20, 16, 5 into a hash table with collisions resolved by chaining. Let the table have 11 slots, and let the hash function be $h(k) = (2k + 5) \bmod 11$.

Exercise 4. *Weight: 30%*

1. Draw the hash table of length $m = 13$ resulting from hashing the keys 8, 12, 40, 13, 88, 45, 29, 20, 23, and 77, using hash function $h(k) = (3k + 1) \bmod 13$ with open addressing and linear probing. Report for every key how often you had to probe unsuccessfully before you could insert the key, and report the total number of unsuccessful probes.

2. What is the result if instead we assume collisions are handled by double hashing with a primary hash function $h'(k) = h(k)$ and a secondary hash function $h''(k) = k \bmod 15$? Report for every key how often you had to probe unsuccessfully before you could insert the key, and report the total number of unsuccessful probes.

Exercise 5. *Weight: 30%*

During the lecture, the procedures for inserting, deleting and searching in an open address hash table were not discussed in detail. Deletion is the difficult operation to implement. A DELETE operation cannot simply mark a slot as empty (or NIL), because this will isolate records further down the probe sequence. We also do not want to make positions in the hash table unusable because of deletion. Both problems can be resolved by placing a special mark in place of a deleted record, called a *tombstone*. The INSERT procedure may treat tombstones as if they were empty, and the search procedure may pass over tombstones while searching. Write pseudocode for the INSERT, DELETE, and SEARCH procedures.