

CSE 332: Data Abstractions

Assignment #5

October 31, 2011

due: Monday, November 7, 12:30 p.m.

1. Insert the integers 87, 19, 25, 55, 36, 46, 88, 7, 67, 21 (in this order) into an initially empty hash table of size 11 using the hash function  $h(x) = x \bmod 11$ ,
  - (a) using separate chaining.
  - (b) using open addressing with linear probing.
  - (c) using open addressing with double hashing, where  $h_2(x) = 1 + (x \bmod 10)$ .
  - (d) If a hash table is going to be this full (i.e.,  $n \approx m$ ) most of the time, and you have a hash function that spreads the entries over the hash table reasonably well, which of these methods is likely to be fastest, and why?
2. The `remove` procedure of Figure 5.17 for deletion from a hash table with open addressing uses “lazy deletion”.
  - (a) Starting from an empty hash table, give an example with *as few dictionary operations as possible* that demonstrates that using “full deletion” can cause the hash table to return the incorrect result for some operation. Make your example complete:
    - State the table size, probing strategy, and hash function.
    - Provide the sequence of operations and the state of the hash table after each operation.
    - Demonstrate how lazy deletion leads to the correct result.
    - State the incorrect result that will occur using full deletion.
  - (b) When rehashing to a larger table, do lazily-deleted items need to be included? Explain your answer.
3. Solve the following recurrence for  $T(n)$ :

$$\begin{aligned}T(1) &= c \\T(n) &= 2T(n/2) + d\end{aligned}$$

where  $c$  and  $d$  are constants independent of  $n$ .

4.
  - (a) Given an acyclic directed graph  $G = (V, E)$  representing course prerequisites, write an algorithm that computes a schedule for completing all the courses in the minimum number of academic terms, with each course completed in the earliest possible term. Your algorithm should assign a term number `v.term` to every vertex `v`, beginning with term number 1. Assume that there is no limit on how many courses can be taken in any given term and that every course is offered every term.
  - (b) Show the result of running your algorithm on the graph of Figure 9.3.
  - (c) What is the asymptotic running time of your algorithm in terms of  $n = |V|$  and  $e = |E|$ ? Justify your answer.