Math 382

Homework 4

Due Monday, February 29

1. Say that we have a hash table with 9 bins. For each of the following hash functions, draw a representation of the table after the keys 5, 28, 19, 15, 20, 33, 12, 17, and 10 have been inserted into it (in that order). How long is the largest chain? How many of the elements have collisions?

   (a) $h(k) = k \,\%\, 9$

   (b) $h(k) = \lfloor 9(k\sqrt{2} \,\%\, 1) \rfloor$

2. Consider inserting the keys 10, 22, 31, 4, 15, 28, 17, 88, and 59 into a hash table (in that order). Let the hash table have size $m = 11$ and use open addressing with the auxiliary hash function $h'(k) = k \,\%\, m$. For each of the following, illustrate the resulting table. (The constants listed are given names consistent with their use in the book's definition of each probe sequence technique.)

   (a) Linear probing

   (b) Quadratic probing with $c_1 = 1$ and $c_2 = 3$

   (c) Double hashing with $h_1(k) = k \,\%\, m$ and $h_2(k) = 1 + (k \,\%\, (m-1))$

3. In class we discussed a worst-case $O(n)$ algorithm for computing order statistics. This algorithm worked by splitting the input list into groups of 5, finding the median of each group, finding the median of those medians, and then using that median for a quicksort-style partition.

   (a) If instead of splitting the elements into groups of 5, we split them into groups of 7, what would the running time be?

   (b) What if instead we used groups of 3?