Homework 6

22C:44 Algorithms, Fall semester 2000

Four problems, ten points each. Due on Tuesday October 24

1 Exercise 12.4-1, page 240. For all three techniques, report the final content of the hash table. Also count the total number of probes executed when inserting the keys.

2 (Programming exercise) Experiment with the following three multiplication method based hash functions. In all cases, hash N consecutive keys $k = 0, 1, 2, \ldots, N-1$ into $m = 100$ slots. Experiment with $N = 1000$, $N = 10000$ and $N = 100000$. In each case, report the minimum and the maximum number of keys stored in any single slot of the table. Which choice of A seems to satisfy the uniform hashing property best? How many non-empty slots do we have in case (b) ?

   (a) $A = (\sqrt{5} - 1)/2$.

   (b) $A = 7/11$.

   (c) $A = 31/127$.

   Note: be sure to use sufficient precision in your calculations.

3 A town has a circular one-way street around the downtown area, with parking spaces on the side of the road. On busy days people look for a place to park by driving along the street and taking the first free space they see. Assuming that cars enter the street from all directions with equal probability, is it more likely that the last two parking spaces are next to each other, or that they are at (precisely) opposite sides of the town? Explain what, if anything, this question has to do with any of the hashing techniques we have learned.

4 Let us introduce a `Deletion` operation to the open addressing technique. When an element is deleted from the hash table a special `Tombstone` symbol is placed in the slot that used to contain that element. Why cannot we simply write `nil` in that slot ? Write pseudocode for dictionary operations `Search`, `Insert` and `Delete`. Then write an algorithm that cleans the hash table by removing all `Tombstone` symbols. After cleaning the table all elements of the dictionary should be still accessible by the `Search` routine.