Theory Homework 3

Data Structures and Algorithms in JAVA
Shlomo Hershkop
Department of Computer Science
Columbia University
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Out: Oct 9 2013
Due: Oct 27 11pm

1) (12 points) Given input {3471, 3123, 1673, 1499, 3444, 6979, 8989} and a hash function h(x)=x(mod 10), show the resulting:
    a. Separate chaining hash table.
    b. Open addressing hash table using linear probing.
    c. Open addressing hash table using quadratic probing.
    d. Open addressing hash table with second hash function h2(x) = 7 - (x mod 7).

2) (4 points) suppose you know in advance information about all the keys that will be inserted into the hash table, is it possible to design a hash function to guarantee no collisions?? if yes, what information do you need to know ? is this a general algorithm ?

3) (10 points) Show the result of inserting 23, 25, 14, 27, 19, 18, 21, 28, 24, 22, 20, 17, 24, 26, 15, one at a time, into an initially empty binary heap. You need to show the heap tree after each 3 insert operations.

4) (4 points) List any two collision resolution strategies and show the advantage and disadvantage of each with standard hashtables.

5) (4 points) Explain what is wrong with this strategy with hashtables:
in order to save space, assuming we are using lazy deletion, during insertions, if we encounter a 'deleted' item, we simply replace it with the item to be inserted.

6) (3 points) What is the running time of Heapsort for presorted input ie input which is already in ascending order?

7) (8) A sorting algorithm is *stable* if duplicates retain their relative positions in the sorted sequence. For example, consider the following list of names:

```
George Bush
Al Gore
Hillary Clinton
Ronald Reagan
Rick Lazio
George W. Bush
Ralph Nader
```

If this list is sorted by last name *only*, then a stable sort will produce this list:

```
George Bush
George W. Bush
Hillary Clinton
Al Gore
Rick Lazio
Ralph Nader
Ronald Reagan
```

whereas an unstable sort might produce this list:

```
George W. Bush
George Bush
Hillary Clinton
Al Gore
Rick Lazio
Ralph Nader
Ronald Reagan
```

Which of the following sorts is stable:
insertion sort, selection sort, bubble sort, mergesort, heapsort, quicksort? For each one, describe why it is or is not stable.

8) (4 points) Compare the advantage and disadvantage of keeping a bunch of items in a hashtable vs keeping the items in an AVL tree.

9) What are the runtime for huffman tree compression ? and decompression ?

10) Describe a quick algorithm for converting a min-heap to max-heap