CISC 220 – Regular section

Final

Wednesday, December 15, 2010

This exam is worth 15% of your grade. Read all instructions before answering—some questions are multi-part. Partial credit will be given in 0.25-point gradations; show your work where possible. Write your answers on both sides of exam pages as necessary.

Q1 (2 points)

Draw the 11-slot hash table, including intermediate steps, that results from using the hash function $h(k) = (2k + 5) \bmod 11$ to hash the keys 88, 94, 23, 39, 42, 11, 36, and 14 (in that order) using linear probing. What is the average number of probes per insertion (treating a no-collision insertion as 0 probes)?

Q2 (1 point)

What does *lazy deletion* mean in the context of hash table probing and why is it necessary?

Q3 (1 point)

What does it mean for a hash function h to be "one-way"? Why is this important if we want to use h for password storage?

Q4 (2 points)

Show each pass of the radix sort algorithm working on the base-10 sequence 185, 224, 563, 945, 126, 31, 926, 950.

Q5 (1 point)

True or false: The worst-case time for any correct implementation of quicksort to sort an array of *n* elements is O(*n log n*). Explain.

Q6 (1 point)

How long does it take to determine if an undirected graph contains a vertex that is connected to no other vertices (1) Using an adjacency matrix representation; (2) Using an adjacency lists representation? Explain briefly.

Q7 (2 points)

Suppose you want to compress a file containing the following string: "*peter piper picked a peck of pickled peppers*". How many bits does the normal ASCII representation require? What is the number of bits required for this file using a code with an equal number of bits per character?

Q8 (3 points)

Consider a graph whose vertices are labeled with the letters A through I, with the neighbors of each vertex given by the table below:

vertex	*neighbors*	*vertex*	*neighbors*
A	(B, D, E)	F	(C, H, I)
B	(A, C, E)	G	(D, E, H)
C	(B, F)	H	(F, G, I)
D	(A, E, G)	I	(F, H)
E	(A, B, D, G)		

Assume that in any search of this graph the neighbors of a given vertex are explored in alphabetical order. Sketch the graph and show your work for the following:

(a) Give the sequence of vertices visited using a *depth-first search* starting at vertex A.
(b) Give the sequence of vertices visited using a *breadth-first search* starting at vertex A.

Q9 (2 points)

Consider the following disjoint set in array form. Sketch the "forest of trees" that it corresponds to before *and* after applying `union(6,3)` then `union(9,3)` using union-by-size.