國立台灣科技大學九十五學年度碩士班招生試題

系所組別： 電子工程系碩士班甲組

科　　目： 資料結構

Total : 100 points

1. (10%)

(a) (5%) What is the time complexity of an algorithm?

(b) (5%) How do we know that an algorithm is optimal for a problem?

2 (10%)

Please describe the stack ADT. Using the stack ADT, give an algorithm to copy the contents of one stack into another. The orders of the stacks must be identical.

3 (10%)

A double ended queue (deque) is a linear list for which elements can be added to or deleted at the front or the tail. Using array implementation, write an algorithm to add elements at either end.

4. (10%)

A k-ary tree is a tree in which every internal node has exactly k children. Show that a k-ary tree with n internal nodes has $(k\text{-}1)(n\text{-}1) + k$ leaves.

5. (10%)

Consider the sequence of keys inserted in an initially empty balanced binary search tree T: 2, 7, 8, 1, 5, 6, 4, 3. Draw tree T after each insertion in the following two cases:

(1) (5%) T is an AVL tree and

(2) (5%) T is a red-black tree.

Show all the intermediate results.

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6. (10%) Please describe how to store n items, $d_1, d_2, \ldots\ldots, d_n$ such that we can search for any item d_i ($1 \leq i \leq n$) in O(log$n$) time ?

7 (10%) Web Cache (Proxy Server) can speed up web access on Internet. Generally, we perform the following operations on the Web Cache.

(a) Determine if a particular URL (universal resource locator) in Web cache. If yes, retrieve the web page of the URL.

(b) Insert a new URL and its web page

(c) Delete a URL and its web page.

Please design a data structure to implement search, insert and delete operations efficiently in Web cache, with a good expected performance. If b = the number of head node in your data structure and n = number of URLs in Web Cache, the expected number of URL comparison is approximate to n/b in searching a particular URL, which is not in the Web Cache. Explain your data structures in details

8. (15%) An operating system schedules processes based on the anticipated run time with shortest-job-first policy. Table 1 contains 8 processes and their anticipated run time. Each process is inserted into the scheduler according to the sequence shown in Table 1. (First J1, then J2, J3...)

(1) (7%) Please design a data structure to implement shortest-job-first scheduler, in which both process insertion and process deletion can be performed in O (log n) time, where n is number of processes in the scheduler

(2) (8%) Please design an algorithm to reorganize your data structure in 8(1) after the running process is completed and deleted from the scheduler. (e.g. J5 is deleted from the scheduler)

Table 1

Process Identifier	Anticipated run time (ms)
J1	7
J2	16
J3	49
J4	82
J5	5
J6	31
J7	6
J8	22

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9 (15%) Given a graph G2 as shown in Figure 1

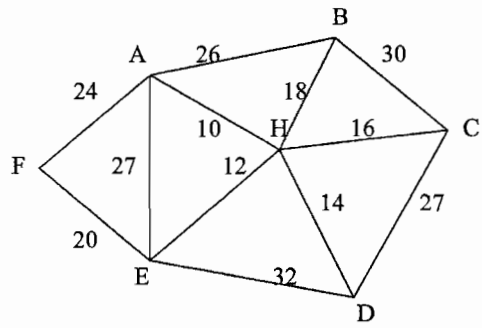

Figure 1 Graph G2

(a) (8%) Please deign a heuristic algorithm to find a minimum-cost spanning tree of **G2, with the degree of each vertex of the spanning tree ≦ 3.** The number of vertices adjacent to vertex v is called the degree of vertex v. (Notes: your heuristic algorithm is **not required** to find a minimum-cost spanning tree in a **General Graph**)

(b) (7%) Please draw the minim-cost spanning tree obtained from your algorithm in 9(a) and calculate the total cost of the spanning tree