題號： 292

科目： 資料結構(A)

節次： 2

國立臺灣大學 112 學年度碩士班招生考試試題

題號：292

共 1 頁之第 1 頁

1. (20%) (a) Please explain what **2-3 trees** are. (b) Please list the advantages of using **red-black trees** to implement the concept of 2-3 trees.

2. (20%) Please write a pseudocode function to achieve the following task: Given a binary tree stored in an array (**heap**) as the input, check if it is a min-heap or not. Your function must return a Boolean value as the output (**true**: the input is a **min-heap**; **false**: the input is not a min-heap).

3. (10%) Suppose that a **digraph** (directed graph) G, containing V vertices and E edges, is represented using the **adjacency-list** representation. What is the order of growth of the running time to find all vertices that have a direct edge to a given vertex v?

4. (10%) How many strongly connected components (SCC) does a **DAG** (directed acyclic graph) on V vertices and E edges have?

5. (10%) When implementing the data structure of **queue** with a **linked list**, which of the following design is better, (a) or (b), when efficiency is considered? (a) insert at the front of the linked list and remove from the end of the linked list; (b) insert at the end of the linked list and remove from the front of the linked list; Please justify your answer.

6. (16%) What are the worst-time complexity of the **insert** and **delete-max** operations, respectively, for **priority queue** of size N in the following four implementations: (a) unordered linked list; (b) ordered array; (c) binary heap; and (d) binary search tree.

7. (14%) How to construct a **heap** in linear time complexity? Please justify your answer.

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