國立臺灣科技大學
九十一學年度碩士班招生考試試題

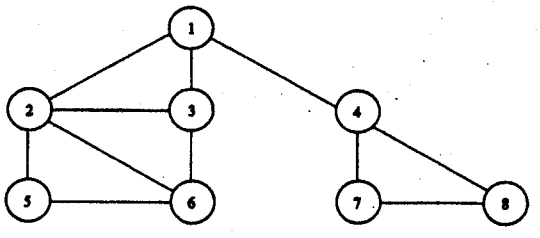
系所組別： 資訊管理系甲組
科　目： 資料結構

總分100分

1. Compare the differences between "heap" and "binary search tree". (20%)

2. There are n objects and a knapsack. Object i has a weight w_i and the knapsack has a capacity M. If a fraction $x_i, 0 \leq x_i \leq 1$, of object i is placed into the knapsack then a profit of $p_i x_i$ is earned. The objective is to obtain a filling of the knapsack that maximizes the total profit earned. Since the knapsack capacity is M, we require the total weight of all chosen objects to be at most M. State the algorithm which obtain the maximum profit and, at the same time, does not exceed the capacity of the knapsack. (15%)

3. Show the process of finding all articulation points of the following graph. (15%)



4.(30%) A 2-d tree has the following node data structure:

```
nodetype = record
    INFO: char(20);
    XVAL: real;
    YVAL:real;
    LLINK: ↑ nodetype;
    RLINK: ↑ nodetype
end
```

If N is a node in a 2-d tree, the level of N is defined as

$$\text{level(N)} = \begin{cases} 0, & \text{If N is the root of the tree} \\ level(P)+1 & \text{If N's parent is P} \end{cases}$$

A 2-d tree is any binary tree satisfying the following conditions

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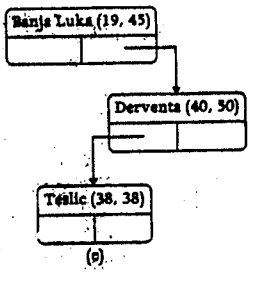
(i). If N is a node in the tree such that level(N) is even (偶數), then every node M in the subtree rooted at N.LLINK has the property that M.XVAL < N.XVAL, and every node P in the subtree rooted at N.RLINK has the property that P.XVAL ≧ N.XVAL.
(ii) If N is a node in the tree such that level(N) is odd(奇數), then every node M in the subtree rooted at N.LLINK has the property that M.YVAL < N.YVAL, and every node P in the subtree rooted at N.RLINK has the property that P.YVAL ≧ N.YVAL.
(簡單的說：偶數層節點是以第一欄位 XVAL 比大小，而奇數層節點是以第二欄位 YVAL 比大小)
Now we have the following information to be inserted into a 2-d tree, the INFO field contains the name of a city.

City	(XVAL, YVAL)
Banja Luka	(19, 45)
Derventa	(40, 50)
Teslic	(38, 38)
Tuzla	(54, 40)
Sinj	(4, 4)

Answer the following problems:
(a). Complete the construction of the 2-d tree for the information in the table mentioned above (10%).



(b) Write a procedure 2DInsert(p, t) to insert a node pointed by p into a 2-d tree pointed by t. (10%)
(c) Describe (敘述) how do you perform range query in the 2-d tree? A range query prints all records that satisfy the constraints low1 ≦ XVAL ≦ high1 and low2 ≦ YVAL ≦ high2. (10%)

5. (20%)
(a). Give the definition of a heap data structure. (5%)
(b) Given array A which contains (23, 6, 14, 17, 13, 10 ,1, 5, 7, 12). Please arrange the order of the elements such that array A becomes a heap.(5%)
(c) Using array A to demonstrate the procedure of heap sort. (10%)