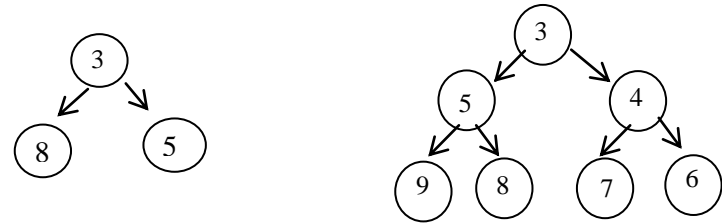


國立嘉義大學 107 學年度
資訊工程學系碩士班招生考試試題

科目：資料結構

1. Please draw the binary min heap after performing the following operations. (10%)

- (a) Insert 6 to the binary min heap shown on the left-hand side below.
 (b) Delete 3 from the binary min heap shown on the right-hand side below.



2. What are the time complexities of the following functions, namely p1() ~ p4()?

No explanation is required. (20%)

```

void p1(int n) {
    for(int i=0; i < n; i++) {
        for(int j=0; j < n; j++) {
            for(int k=0; k < n; k++) {
                for(int m=0; m < n; m++) {
                    printf("!");
                }
            }
        }
    }
}

void p2(int n) {
    for(int i=0; i < n; i++) {
        for(int j=0; j < 10; j++) {
            for(int k=0; k < n; k++) {
                for(int m=0; m < 10; m++) {
                    printf("!");
                }
            }
        }
    }
}

int p3(int n) {
    if (n < 10) {
        printf("!");
        return n;
    }
    else {
        return p3(n-1) + p3(n-1);
    }
}

int p4(int n) {
    if (n < 10) {
        printf("!");
        return n+5;
    }
    else {
        return p4(n-1) + 2;
    }
}
    
```

3. When we use Kruskal's algorithm to solve the minimum spanning tree problem, an edge is added if it does not create a cycle. We use **disjoint sets** data structure to determine whether two vertices belong to a same set. In disjoint sets, the uptrees are used to represent sets in the union-find algorithm. And, uptrees can be stored in two n -element arrays, where n is the number of items. The **up** array stores the parent of each node. The **weight** array stores the number of items in a set if the node is the root of a set. The weight array is ignored in this problem. (20%)

	1	2	3	4	5	6	7	8	9
up	6	6	-1	3	8	-1	6	3	-1
weight									

- (a) Draw the uptrees represented by the data in the **up** array in the above table.
 (b) Draw the uptrees after performing union(find(2), find(8)) on the above data.

4. What is a binary search tree? Explain the reasons that a binary search tree should be balanced with respect to the heights of subtrees. (20%)
5. A list of n integers may contain duplicate elements of the same value. Give a method that can find all duplicate elements faster than $O(n^2)$. Explain your answer. (20%)
6. Explain the reasons that quick sort cannot efficiently sort massive amounts of data that do not fit into available main memory. Describe an external sort algorithm that can efficiently sort data in the slower external memory. (10%)