

大同大學 九十 學年度研究所碩士班入學考試試題

考試科目：資料結構與演算法

所別：資訊經營研究所

第 1/2 頁

註：本次考試 不可以參考自己的書籍及筆記； 不可以使用字典； 不可以使用計算器。

1. (12 pts) **True or False.** If the statement is correct, briefly state why. If the statement is wrong, correct it.
- (a) The solution to the recurrence $T(N) = T(N - 2) + 1$ is $T(N) = O(N)$.
 - (b) The solution to the recurrence $T(N) = 2T(N/2) + N$ is $T(N) = O(N \log N)$.
 - (c) For any asymptotically nonnegative function $f(N)$, we have $f(N) + o(f(N)) = O(f(N))$.
 - (d) An algorithm is $O(N)$ if it takes constant (i.e., $O(1)$) time to cut the problem size by a fraction (e.g., $1/2$).

2. (10 pts) Solve $T(N)$ in each of the following recurrences. Assume that $T(N)$ is constant for $N \leq 2$. Make your bounds as tight as possible, and justify your answers.

a) $T(N) = T(N - 1) + N$. b) $T(N) = T(\sqrt{N}) + 1$.

3. (10 pts) Find the running times (i.e., *complexity* in terms of n) of the following two functions.

```
(a) long factorial( int n )
{
    if( n <= 1 )
        return 1;
    else
        return n * factorial( n-1 );
}
```

```
(b) long gcd( long m, long n )
{
    while( n != 0 ) {
        long rem = m % n;
        m = n;
        n = rem;
    }
    return m;
}
```

4. (12 pts) A full node is a node with two children. Let $f(N)$ be the average number of full nodes in a binary search tree. Determine the values of $f(0)$ and $f(1)$; find the equation of $f(N)$ for $N > 1$, and show that it is $O(N)$.
5. (12 pts) (a) Sort 10, 3, 5, 7, 9, 4, 2, 6, 1, 8 step by step using quicksort with median-of-three partitioning and a cutoff 3; (b) Explain why this sequence is the worst possible permutation of 10 elements for the algorithm.
6. (10 pts) There are 1000 persons, one person starts to make phone call to two persons. Each person subsequently called another two persons who have not been called. (a) How many calls will be made totally? (b) How many people will not make calls? Explain your answers!
7. (10 pts) The preorder traversal of a binary tree is ABCDEFGHI and its inorder traversal is BDCAFGEIH.
- (a) Determine the unique binary tree and its postorder traversal.
 - (b) Determine the order in which the node (of this tree) will be visited by invoking function $g()$.

```
f(NODEPTR tree)
{
    if (tree != NULL) {
        printf("%d", tree->info);
        g(tree->left);
        g(tree->right);
    }
}

g(NODEPTR tree)
{
    if (tree != NULL) {
        f(tree->left);
        printf("%d", tree->info);
        f(tree->right);
    }
}
```

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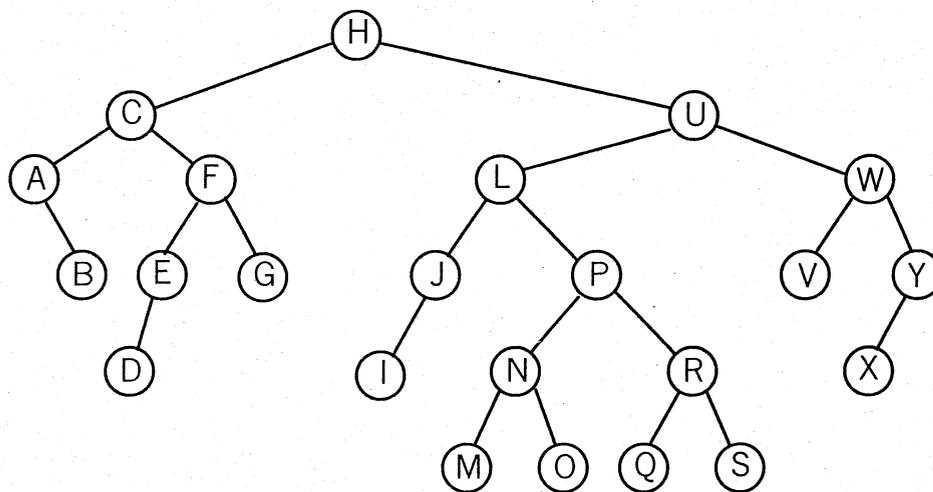
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第 2/2 頁

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8. (12 pts) (a) How many nodes an AVL tree of height 4 must have?
(b) Try to insert "T" into the following AVL tree and perform the rotations if necessary.
(c) Does it require any rotations if we try to insert "K" into the following AVL tree? Why?



9. (12 pts) Find a minimum spanning tree for the graph below using
(a) Prim's algorithm; (b) Kruskal's algorithm; (c) Is this minimum spanning tree unique? Why?

