

CSE 312 2. Midterm

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I. QUESTION (20 POINTS)

Give a big-Oh characterization, in terms of n , of the running time of the following subprograms. Show your work.

```
a.)
sum = 0;
for (i = 0; i < N; i++)
    for (j = 1; j < N; j *= 2)
        sum++;

b.)
int multiply(int[] A, int n){
    if (n == 0)
        return A[0];
    else
        return A[n] * multiply(A, n-1);
}
```

II. QUESTION (20 POINTS)

You are given an array where the first part of the array is sorted and the second part unsorted. For example, the array contains 3, 5, 7, 10, 17, 24, 6, 4, 18 where 3, 5, 7, 10, 17, 24 is the sorted part of the array and 6, 4, 18 is the unsorted part of the array. Give efficient algorithms to sort the whole array if

- The unsorted part contains only a single integer.
- The unsorted part contains $\log N$ integers.

Assume that there are N integers in the sorted part of the array.

III. QUESTION (15 POINTS)

In what order would you insert the numbers 1, 2, 3, 4, 5, ..., 31 into a binary search tree so that the tree is fully balanced?

IV. QUESTION (20 POINTS)

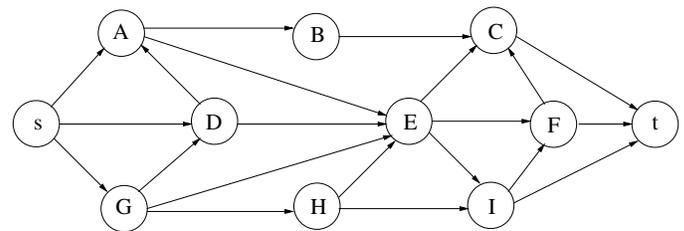
Let $A = \{a_1, \dots, a_n\}$ and $B = \{b_1, \dots, b_m\}$ be two sets of numbers. Consider the problem of finding their difference, $A \setminus B$, the set of all numbers that are in A but not in B .

- Design a brute-force algorithm to solve this problem.
- Design a presorting based algorithm to solve this problem.

V. QUESTION (15 POINTS)

How would you use DFS (Depth first search) to do topological sort? Give the algorithm and explain on example graph with 7 vertices.

VI. QUESTION (10 POINTS)



Apply BFS (Breadth first search) on the graph given above. Start with vertex s .