

CSE 312 Final

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I. QUESTION (5 POINTS)

The following program find the greatest common divisor of two numbers. Fill the blanks.

```
int gcd(int a, int b){
    if (a == b)
        return a;
    else if (a > b)
        return gcd(a - b, b);
    else
        return gcd(.....);
}
```

II. QUESTION (16 POINTS)

The array A contains N integers (positive or negative). The following program finds the subsequence with the maximum sum. Fill the blanks so that the program will output the maximum sum and the finishing index of the maximum subsequence.

```
p = 0;
s = 0;
for (k = 0; k < N; k++){
    if (A[k] + s > p){
        .....
    }else if (A[k] + s > 0){
        .....
    }
    else{
        .....
    }
}
printf("%d", p);
printf("%d", i);
```

For example if A is (1, -2, -3, 3, -1, 3, -8, 1, 3, -1, 1, -1) the program will print 5 and 5, because the maximum subsequence is 3, -1, 3 with sum 5 and finishing index of 5.

III. QUESTION (15 POINTS)

Let say we have N numbers. Our aim is to get the following objectives as fast as we can. What is the order of time complexities from the smallest to the largest?

a) Find the largest one.

b) Sort the numbers.

c) Find the k 'th largest number.

IV. QUESTION (14 POINTS)

What is the value of the variable m after the following code executes?

```
m = 0;
n = 10;
for (a = 1; a <= n; a++)
    for (b = 1; b <= a; b++)
        for (c = 1; c <= b; c++)
            m++;
```

V. QUESTION (14 POINTS)

A program sorts n numbers according the following algorithm:

- Finds the two largest of n numbers by making $2n - 3$ comparisons.
- Sorts remaining $n - 2$ numbers recursively using the same algorithm.

What is the time complexity of the algorithm?

VI. QUESTION (16 POINTS)

Explain what adjustments need to be made in Dijkstra's algorithm to solve the following problems.

- Find the shortest paths to a given vertex from each other vertex of a weighted graph
- Solve the single-source shortest-paths problem in a graph with nonnegative numbers assigned to its vertices (and the length of a path defined as the sum of the vertex numbers on the path)

VII. QUESTION (20 POINTS)

Let $A = \{a_1, a_2, \dots, a_n\}$ and $B = \{b_1, b_2, \dots, b_n\}$ be two sets of numbers. Consider the problem of finding their unions, i.e., the set C of all the numbers that are in A or B.

- Design a brute-force algorithm for solving this problem in $O(n^2)$ time.
- Design a presorting-based algorithm for solving this problem in $O(n \log n)$ time.