

CSE 312 Final

Olcay Taner YILDIZ

I. QUESTION (ALGORITHM ANALYSIS) (10 POINTS)

Given the following function

```

1 int algorithm1(int N){
2   int sum = 0;
3   for (int i = 1; i <= N; i++){
4     for (int j = i; j <= N; j++){
5       for (int k = j; k <= N; k++){
6         sum++;
7       }
8     }
9   }
10 }
```

What is the value of sum after the execution of the algorithm1?

II. QUESTION (ALGORITHM ANALYSIS) (10 POINTS)

Given the following function

```

1 int algorithm2(int N){
2   if (N == 0)
3     return 0;
4   int sum = 0;
5   for (i = 0; i < N; i++){
6     sum++;
7     if (sum > N)
8       return algorithm2(N / 2) - N;
9   }
10  else
11  return algorithm2(N / 2) + N;
12 }
```

What is the time complexity of the function algorithm2?

III. QUESTION (BRUTE FORCE) (16 POINTS)

You are given an integer matrix of $A[][]$, which is the adjacency matrix of a graph. Write a function that checks if the graph has the circular topology.

```
boolean circularTopology(int [][] A)
```

IV. QUESTION (DIVIDE AND CONQUER) (16 POINTS)

Write a recursive pseudocode for computing the length of the longest path to a leaf node in a binary tree.

V. QUESTION (DYNAMIC PROGRAMMING) (16 POINTS)

You are given an n by n board. Write a dynamic programming algorithm to find the number of possible paths from (1,1) to (n, n). There are also holes in the board, where you can not pass. The positions of the holes are given by the matrix A, where $A[i][j]$ is 1 if there is a hole in row i col j ; otherwise $A[i][j]$ is 0.

```
int numberOfPaths(int [][] A)
```

VI. QUESTION (PRESORTING) (16 POINTS)

You have an array A of n integers and another integer s . Find out whether the array contains four elements whose sum is s . Write a presorting algorithm of complexity $O(N^2 \log N)$.

```
boolean containsFourOfSumS(int [] A)
```

VII. QUESTION (GREEDY) (16 POINTS)

The swap sorting of permutation π is a transformation of π into the identity permutation by exchanges of adjacent elements. For example, 3142 \rightarrow 1342 \rightarrow 1324 \rightarrow 1234 is a three-step swap sorting of permutation 1234. Write a greedy algorithm for swap sorting that uses the minimum number of swaps to sort a permutation.

```
void swapSort(int [] A)
```