CSE 312 Midterm 1

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I. Question (Algorithm Analysis) (15 points)

Given the following function

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

What is the time complexity of the function algorithm1?

II. Question (Algorithm Analysis) (15 points)

Given the following function

```
1  int algorithm2(int N){
2    int sum = 0;
3    if (N == 0)
4      return 0;
5    for (i = 0; i < N; i++)
6      for (int j = 0; j < N; j++)
7        sum++;
8    return algorithm2(N − 1) + sum;
9  }
```

What is the time complexity of the function algorithm2?

III. Question (Algorithm Analysis) (20 points)

Prove that $\frac{1}{2}n(n+1) \in \Theta(n^2)$.

IV. Question (Algorithm Analysis) (10 points)

Sort the following functions in the order of growth.

$2^n, n, n^3, n!, n \log n, n^2, \log n$

V. Question (Brute Force) (20 points)

Write a brute force algorithm to calculate the least common multiple of two numbers m and n.

```
int lcm(int m, int n)
```

VI. Question (Brute Force) (20 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 topology of a star.

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