CSE 312 Final

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I. Question (Algorithm Analysis) (15 points)

Given the following function

```
int algorithm(int N){
  if (N == 1)
     return 0;
  sum = 0;
  for (i = 0; i < N; i++)
     for (j = 0; j < N; j++)
        sum++;
  return algorithm(N / 4) + sum;
}
```

What is the time complexity of algorithm?

II. Question (Brute Force) (20 points)

Let A = $\{a_1, a_2, \ldots, a_n\}$ and B = $\{b_1, b_2, \ldots, b_n\}$ be two sets of numbers. Consider the problem of finding their intersections, i.e., the set C of all the numbers that are both in A and B. Design a brute-force algorithm for solving this problem in $\mathcal{O}(n^2)$ time.

III. Question (Divide and Conquer) (15 points)

Use Divide and Conquer strategy to find all the elements in a sorted array whose values fall between two given values L and U (inclusively) in $\mathcal{O}(\log n)$ time.

IV. Question (Graph Algorithms) (20 points)

Given the adjacency matrix representation of a graph G, return the incoming nodes to a given node i as a linked list.

```
LinkedList incomingNodes(int i)
```

V. Question (Greedy) (15 points)

There are n men who need to be married to n women, one man to one woman. The happiness that would occur if the ith man is married to jth woman is given in a matrix C_{ij}. The problem is to find an assignment with the maximum happiness. Your function will return an array of man indexes which are married to the women.

```
int[] married(int[][] C)
```

VI. Question (Dynamic Programming) (15 points)

Consider two teams, A and B, playing a series of games until one of the teams wins n games. Assume that the probability of A winning a game is the same for each game and equal to p, and the probability of A losing a game is q = 1 - p (Hence, there are no ties). Let P(i, j) be the probability of A winning the series if A needs i more games to win the series and B needs j more games to win the series.

- Set up a recurrence relation for P(i, j) that can be used by a dynamic programming algorithm.
- Write a pseudocode of the dynamic programming algorithm for solving this problem.