CSE 312 Midterm I

Olcay Taner YILDIZ

I. Question

In each of the following situations, prove or disprove $f \in \mathcal{O}(g)$.

f(n)	g(n)
n - 100	n - 200
$n!$	2^n
2^n	2^{n+1}
$n^{1/2}$	$n^{2/3}$

II. Question

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

```
a.)
sum = 0\\
for p = 0 to n do\\
for q = 0 to n-p do\\
     sum = sum + 1\\
b.)
m = 0\\
for a = 1 to n do\\
  for b = 1 to a do\\
     for c = 1 to b do\\
        m = m + 1
```

III. Question

Suppose you are choosing between the following three algorithms:

- Algorithm A solves problems by dividing them into five subproblems of half the size, recursively solving each subproblem, and then combining the solutions in linear time.
- Algorithm B solves problems of size n by recursively solving two subproblems of size $n/2$ and then combining the solutions in constant time.
- Algorithm C solves problems of size n by dividing them into nine subproblems of size $n/3$, recursively solving each subproblem, and then combining the solutions in O(n^2) time.

What are the running times of each of these algorithms (in big-O notation), and which would you choose? Show your work.

IV. Question

Write a brute force algorithm that takes as input a number N and determines whether it is a square, that is, whether is can be written as q^2 for some integer q. You can not use sqrt function.

V. Question

Write an algorithm for range searching, i.e., for finding all the elements in a sorted array whose values fall between two given values L and U (inclusively)? Your algorithm should run in time O($\log n$).