These are the remaining problems for Assignment 1.

For regular students, the deadline is **February 25, Wednesday, in class**.

For special needs students, the deadline is **March 4, Wednesday, in class**.

**Please submit a hard copy of your solution (handwritten or typed) in person in class. No late assignments will be accepted**.

**Special note: Any answer that is not sufficiently clear even after a reasonably careful reading will not be considered a correct answer, and only what is written in the answer will be used to verify accuracy. No vague descriptions or sufficiently ambiguous statements that can be interpreted in multiple ways will be considered as a correct answer, nor will the student be allowed to add any explanations to his/her answer after it has been submitted.**

**Problem 1 (35 points):** Assume that you have two functions $f(n)$ and $g(n)$ such that $f(n) = O(g(n))$. Also, assume that $f(n) \geq 4$ and $g(n) \geq 4$ for all $n$. For each of the following statements, decide whether you think it is true or false and accordingly give a proof (if true) or a counter-example (if false).

(*i*) **(10 points)** $\log_2 f(n)$ is $O(\log_2 g(n))$.

(*ii*) **(15 points)** $2^{f(n)}$ is $O\left(2^{g(n)}\right)$.

(*iii*) **(10 points)** $f(n)^2$ is $O\left(g(n)^2\right)$.

**Problem 2 (15 points):** Give an algorithm to detect whether a given undirected graph is a tree or not. The graph is given to you in its adjacency list representation. The running time of your algorithm should be $O(m + n)$ for a graph with $n$ nodes and $m$ edges.