Analysis of Algorithms
CS 375, Spring 2019
Homework 18
Due **AT THE BEGINNING OF CLASS** Monday, May 6

- From your textbook (CLRS), please read Chapter 34, pages 1061–1065.
- When presenting an algorithm, describe it in English clearly, concisely, and unambiguously; pseudocode often helps clarify a presentation, but a pseudocode-only presentation is not acceptable. In general, unclear presentations may not receive full credit.
- *A general note:* When writing up your homework, please write neatly and **explain your answers clearly**, giving all details needed to make your answers easy to understand. Graders may not award credit to incomplete or illegible solutions. Clear communication *is* the point, on every assignment.

Exercises

By definition (see CLRS Exercise 34-1, page 1101–1102), given a graph $G = (V, E)$, an *independent set* of G is a subset $V' \subseteq V$ of vertices such that each edge in E is incident on at most one vertex in V'.

The Independent Set decision problem can be specified as follows:

Inputs Graph $G = (V, E)$, positive integer $k \leq |V|$

Output Yes (or True) if there is an independent set of size k in G; No (or False) otherwise

Both of the exercises below use this definition.

1. Give a polynomial-time *verification* algorithm to show that the Independent Set problem is in NP. Please be clear about what the *certificate* is that's being used in the algorithm, and as done in class, make sure to describe in English everything the algorithm needs to do to verify that the certificate is a Yes instance of Independent Set, giving an upper bound on the complexity of each step and showing that the algorithm overall is in polynomial time.

   (You can give pseudocode as part of your description of the algorithm to clarify it, if you'd like, but the algorithm must be fully described in English whether or not pseudocode is given.)

2. Give a polynomial-time *reduction* algorithm to solve the Clique problem (i.e., the decision problem), using a hypothetical subroutine that solves the Independent Set problem (i.e., the decision problem).

   (**Note:** As discussed in lecture, you could think of this as one way of showing that if there is a poly-time algorithm for Independent Set, then there is a poly-time algorithm for Clique. Please see me if there are any questions about that!)