Analysis of Algorithms
CS 375, Spring 2019
Homework 18
Due **by 4pm** Thursday, May 9

- From your textbook (CLRS), please read Chapter 34, pages 1067–1070.

- 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

1. Recall from HW17 that the *bin-packing decision problem* can be specified as follows:

   Inputs Set $S = \{i_1, \ldots, i_n\}$ of n items, as described above, and positive integer m.

   Output Yes (or True) if all items in S can be placed into m bins (or fewer); No otherwise.

   Give a polynomial-time *verification* algorithm to show that the Bin-Packing problem is in NP. As before, please be clear about what the *certificate* is that's being used in the algorithm and make sure to describe in English everything the algorithm needs to do to verify that the certificate is a Yes instance of Bin-Packing, 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. Show that the Independent Set problem (as defined on previous HWs) is NP-Complete, under the assumption that the Clique problem is NP-Complete. As always, explain your answer. (Doing this exercise will essentially complete exercise CLRS 34-1 part a, on page 1102.)

   You may use any results from previous CS375 HW exercises as part of your answer here, just be sure to say clearly what result is being used and how it's being used to show the NP-Completeness of Independent Set.