Homework 6

Start Assignment

- Due Monday by 8am
- Points 20
- Submitting a file upload
- File Types pdf
- Available Mar 11 at 8am - Mar 18 at 8am

Suggested reading:

Chapter 8 in [DPV].

Instructions.

NP Reductions are proofs, and as such we require your reduction to include specific content. *We have some unknown Problem B, and we want to show that it is NP-Complete.* To accomplish this you:

1. First demonstrate that problem B is in the class of NP problems. This is, given a candidate solution to an instance of our unknown problem B, we show that you can validate that solution in Polynomial time. (*We are not solving the problem, we are checking that the candidate solution is in fact a complete and valid solution*).

2. Then demonstrate that problem B is at least as hard as a problem known to be NP-Complete. This is done via reduction from a known problem A (A→B). The specific steps are as follows:
   1. Show how an instance of problem A is converted to an instance of problem B in polynomial time
   2. Show how a solution to problem B can be converted to a solution for problem A, again in polynomial time
   3. Show that a solution for B exists ***if-and-only-if (IFF)*** a solution to A exists. You must prove both directions -- if you have a solution to B you have a solution to A; and if there is no solution for B, then no solution exists for A.

Additional details may be found in Ed Discussions. Please be sure to review that thread and ask any follow-up questions as needed.

[DPV] Practice Problems. *(do not turn in)*

[DPV] Problem 8.1 (TSP optimization versus search)

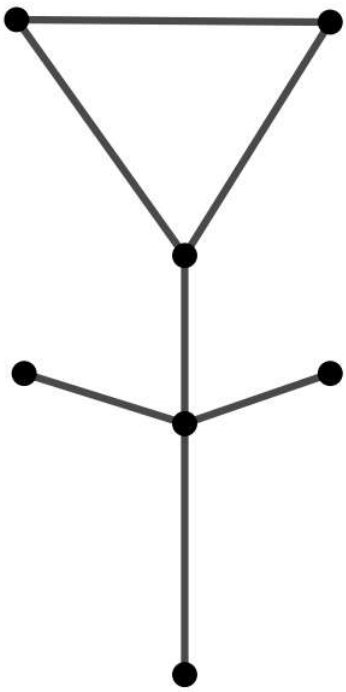
[DPV] Problem 8.4 (a), (b), (c) (Clique-3)

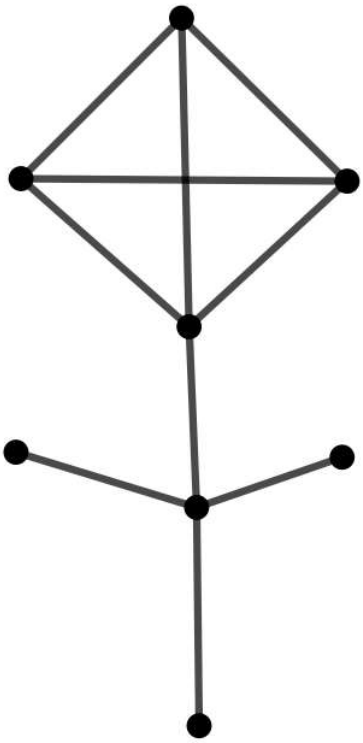
[DPV] Problem 8.8 (Exact 4SAT)

[DPV] Problem 8.10 (a) (Subgraph isomorphism. You are welcome to try them all)

Graded problem.

A ***flower*** of size N is a graph with exactly N+4 vertices such that N vertices form a clique, and the other four form a star connected to the clique by exactly one edge ***to the star's central vertex***. The picture shows flowers of size three and four, respectively.





Consider the *Flower Problem*:

Input: A graph G=(V,E) and a natural number N>0.

Output: a set of N+4 vertices such that the **induced subgraph** (https://en.wikipedia.org/wiki/Induced_subgraph#:~:text=In%20the%20mathematical%20field%20of,of%20vertices%20in%20that%20subset.) is a flower, or report NO if such set does not exist.

Show that the Flower-Search problem is NP-complete.