FIT1045 Intro to Algorithms and Programming – Workshop 12

Objectives

The **objectives of this workshop** are:

- To get used to NP-completeness.
- To create a certificate checker for CLIQUE and INDEPENDENT-SET problem.

Useful Links:

For this workshop, you may find it useful to review some of the following concepts:

- Some known NP-complete problems. (`https://en.wikipedia.org/wiki/NP-completeness`)
- Lecture materials to develop intuition.

In particular, you may find it useful in proving the membership of a problem in class NP.

Task 0 (To be completed before class):

Review workshop 4 (tasks $1-3$) and how to represent a graph as an adjacency list and adjacency matrix from there:

1. Write up a function which accepts a graph in adjacency list format and determines whether any two vertices (Ex. 5 and 2) are adjacent (joined via an edge) in the given graph
2. Repeat this process for an adjacency matrix.

Task 1:

This task will have you verifying that a certificate to the Max-Clique problem. The Max-Clique: Given a graph G, find the largest clique (set of nodes such that all pairs in the set are neighbors).
The decision version of the Problem is: Does G have a clique of size K? Write a python program that takes a graph G, a number k and a possible certificate C to this problem.
Your program returns "yes", if C is a clique of size k in the graph G and "no" otherwise. The graph is given in a file testGraph.txt. A file named cliqueList.txt is also given which contains group of possible cliques of vertices which you will need to check.
For this question you can assume $k = 4$

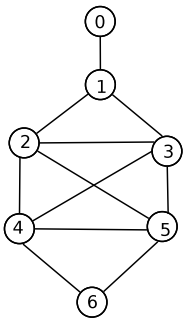

Figure 1: Graph G

For example: Your program might do the following:
Enter the filename for graph: testGraph.txt
Enter the filename for possible cliques: cliqueList.txt
[2,3,4,5] : Yes
[1,2,3,6] : No
[1,2,3] : No
[1,3,6] : No
[0,1,5,6] : No
[1,2,3,4] : No

Task 2:

This task will have you verifying that a certificate to the Max-Independent Set problem. An Independent Set in a graph is a set of nodes with no two of which have an edge.
The decision version of the Problem is: Does G have an independent set of size K?
Write a python program that takes a graph G, a number k and a possible certificate to this problem I. Your program returns "yes", if I is an independent set of size k in the graph G and "no" otherwise.
The graph is given in a file testGraph.txt. A file named independentSet.txt is also given which contains a group of possible independent vertex sets. For this question you can assume $k = 3$.

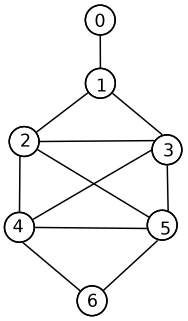

Figure 2: Graph G

For example: Your program might do the following:
Enter the filename for graph: testGraph.txt
Enter the filename for independent set: independentSet.txt
[1,3,5] : No
[1,2,6] : No
[3,6] : No
[0,2,6] : Yes
[0,3,6] :Yes

Task 3:

The complement of a graph G is a graph H on the same vertices such that two distinct vertices of H are adjacent if and only if they are not adjacent in G (Refer Figure 3). Write a program to find the complement of a graph. Use this program to find the complement of the graph discussed in the previous questions. Repeat Task 1 and Task 2 with the complement graph. Discuss your observations with your neighbor/tutor. Try to convince yourself about the observations you make.

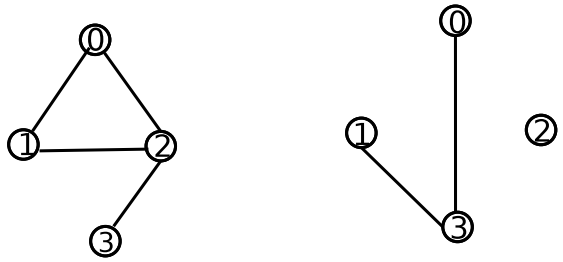

Figure 3: Graph G and its complement