CS 330 – Fall 2019 – Lab 3

Question 1. *Estimating construction duration*

Imagine yourself as a member of the supervisory committee of the new BU Data Science building. Construction involves a sequence of tasks, starting from permit application,..., project bidding,..., and ending with quality inspection. Formulate the problem of estimating the minimum and maximum time it takes from the first day to the last day. Note that certain tasks must be finished before others begin.

Question 2. *Directed acyclic graphs (DAGs)*

Given a *directed* graph $G(V, E)$ decide whether it is a DAG. For this, find an algorithm to check if G contains a cycle. (Hint: try to find the topological order G. What happens if the graph is not a DAG?)

Question 3. *Adapted from Chapter 3, Exercise 11, on p. 111-112 (additional examples in text).*

There are n computers in a system, labeled C_1, C_2,..., C_n, and as input you're given a collection of trace data indicating the times at which pairs of computers communicated. The data is a sequence of triples (C_i, C_j, t_k); such a triple indicates that C_i and C_j exchanged bits at time t_k. There are m triples total. The triples are presented in sorted order of time. If the virus was inserted into computer C_a at time x, could it possibly have infected computer C_b by time y?

Design an algorithm such that, given a collection of trace data, the algorithm should decide whether a virus introduced at computer C_a at time x could have infected computer C_b by time y. The algorithm should run in time $O(m + n)$.

Question 4. *Eulerian path and cycle*

Eulerian path is a path in a graph that passes through all of its edges exactly once. A Eulerian cycle is a Eulerian path that is a cycle. Try a few examples and guess: what are the conditions of the existence of Eulerian path and cycle? How to find them should they exist?