Theorey Assignment-3: ADA Winter-2023

Full Marks: 10, **Deadline:** April 26 at 11:59 pm.

General instructions: While solving the assignment, you are encouraged to discuss with your classmate and/or senior if you want to. In case you do so, please mention the name (and also roll number in case of classmate or institute senior) of the persons you have discussed with. If you look-up the solution in the internet, you must provide the link at which you have seen the solution. Finally, write the solutions in your own language. Copying solution will be reported as plagiarism. You are free to use some algorithm as subrouting taught in the class or in tutorial. This assignment uses the ideas of network flow along with a combination of max-flow min-cut theorem.

(a) First describe how you formulate it as a network flow problem. This part must precisely mention capacities of the edges, and how the directed graphs are designed.

(b) Then, you explain how maximum-flow value in your network is equivalent to the solution to the original problem. In case you need max-flow min-cut theorem also to prove this equivalence, then please mention that as well. If you invoke the ford-fulkerson's algorithm to solve this problem, just mentioning is sufficient. You do not have to elaborate it.

(c) Give a proper explanation of the running time of your algorithm.

Question 1 *The towns and villages of the Island of Sunland are connected by an extensive rail network. Doweltown is the capital of Sunland. Due to a deadly contagious disease, recently, few casualties have been reported in the village of Tinkmoth. To prevent the disease from spreading to Doweltown, the Ministry of Railway of the Sunland wants to completely cut down the rail communication between Tinkmoth and Doweltown. For this, they wanted to put traffic blocks between pairs of rail stations that are directly connected by railway track. It means if there are two stations x and y that are directly connected by railway line, then there is no station in between x and y in that particular line. If a traffic block is put in the track directly connecting x and y, then no train can move from x to y. To minimize expense (and public notice), the authority wants to put as few traffic blocks as as possible. Note that traffic blocks cannot be put in a station, it has to be put in a rail-track that directly connects two stations.*

*Formulate the above as a flow-network problem and design a polynomial-time algorithm to solve it. Give a precise justification of the running time of your algorithm. (***10 Marks***)*