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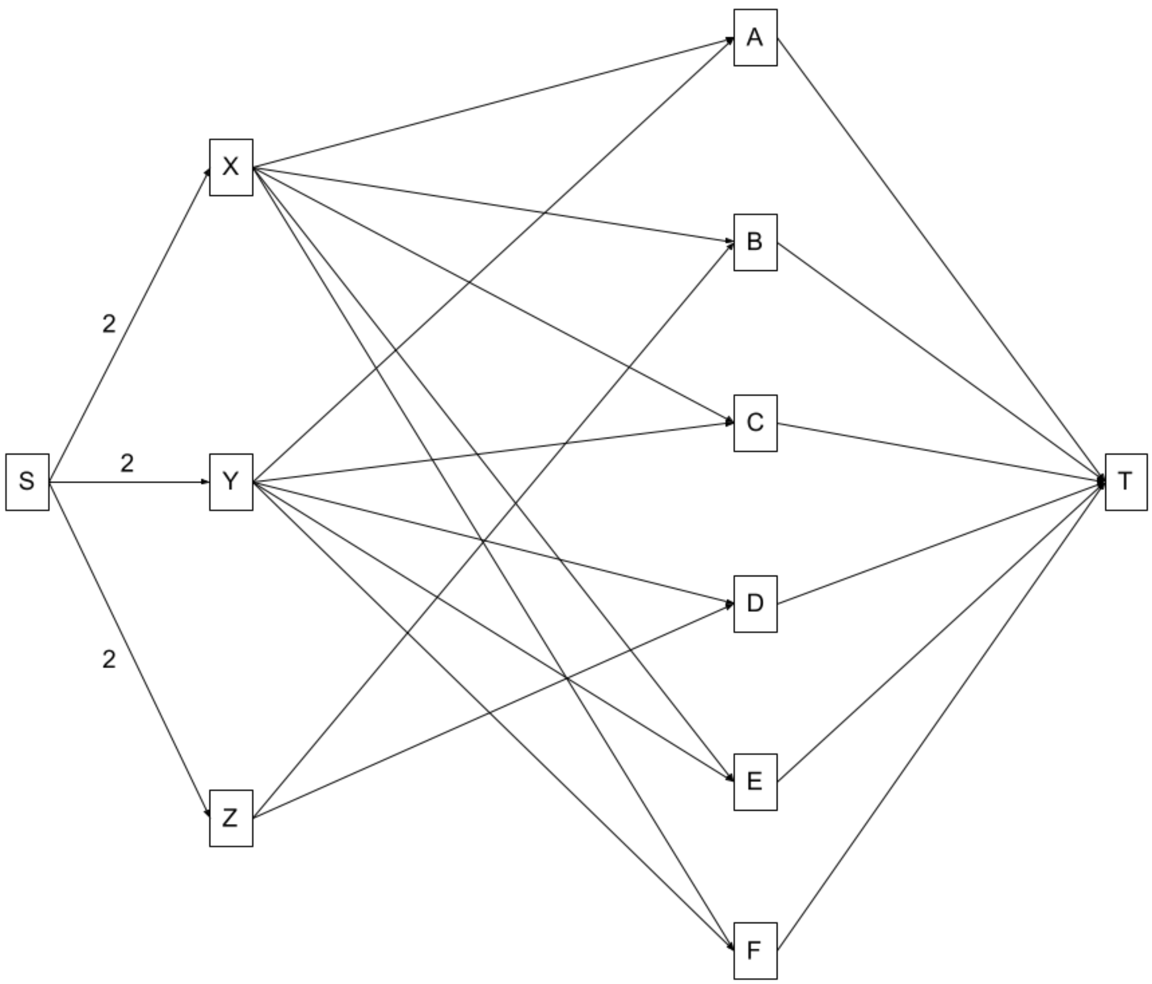
NFApps1

1. Given a set of m Chaburos, n students, and maximum capacity p for each Chaburah, let every student and chabura be vertices and add an edge from every first and second choice of each student to that chabura and assign these edges a capacity of 1. Add s and t vertices. Add edges of capacity p from s to every member of chaburah. Add edges of capacity 1 from every student to t.
Because each chaburah only receives a flow of p and each student can only push a flow of 1 and the connection between m and n are all of the first and second choices of the members of n, the maximum flow will represent the maximum amount of students that can fill the chaburas using one of their first and second choices.

2.



Note: For every edge except for those that are labeled, the capacity is 1.
Note: All edges move from left to right (it is a bit difficult to see the arrows).

3. All of the vertices between the members of n and m that are used to achieve the maximum flow represent the assignments. If the maximum flow = n, this means that there is an assignment. If the maximum flow < n, there is no assignment.

4. 2pn

5. Simply add edges from chaburos to students for each of their top k choices with capacity 1.

6. Add edges from chaburos to students for all of their choices and run the standard network flow algorithm. However, instead of randomly choosing an augmenting path, sort the edges from chaburos to students from top choices to bottom choices and whenever an augmenting path must be chosen, choose from the highest choice available and avoid using back edges if possible. Once a flow has been found such that maximum flow = n, determine the edge of the lowest choice that is part of the maximum flow. The number of choice that this edged represents is k.