AlgoCeption

This is a **regular task**. You must submit a PDF, which can be produced using the LaTeX template on Moodle, exported from a word processor, hand-written or any other method.

COMP3121/9101 has m sessions to teach n students. Due to high demand, each student can only be seen **once** per session they are available for. Students also do not want to have their lives revolving around COMP3121/9101, so they have a limit on the number of sessions they would attend. A *demonstration* occurs when a student is allocated a staff member during a particular session. Students need to demo their tasks with staff at these sessions; otherwise, they become sad because their demo tasks aren't marked. The course staff hate seeing students sad, so they want to know (in theory), the maximum number of demonstrations each week.

More formally, COMP3121/9101 has m sessions where the staff of the ith session can be allocated at most q_i students. There are also n students, where student j has both a list $A_j[1..m]$ of binary values where $A_j[i]$ is 1 if they are available for session i, and 0 otherwise, and a value ℓ_j denoting the maximum number of sessions they would attend.

Design an efficient algorithm that finds the maximum number of demonstrations, using techniques from flow networks. You must justify the correctness of your algorithm, and that your algorithm runs in the time complexity that you claim.

Advice.

You should design a flow network that solves the problem when an appropriate flow algorithm is used with your network as input.

Your flow network should be well-defined; that is, all edges (and their capacities) as well as all vertices should be constructed clearly.

When proving the correctness of your algorithm, you should show that every valid allocation corresponds to a valid flow, and that every valid flow corresponds to a valid allocation. You also need to conclude appropriately.

Expected length: Up to a page and a half.