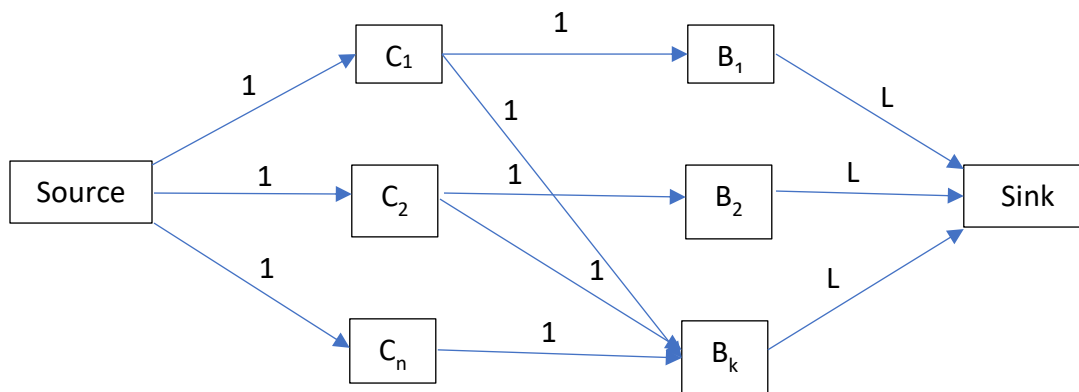


## Assignment 8

## 1. Testing Base Station Coverage

- a. My flow network will start with the clients coming out of the source with edge capacities of 1, since we want each client to be covered. Then the clients will have outgoing edges of capacity 1 to the base stations that they are in range of already. Finally, each base will have one outgoing edge to the sink with an edge capacity of  $L$  since each base can only have  $L$  clients.

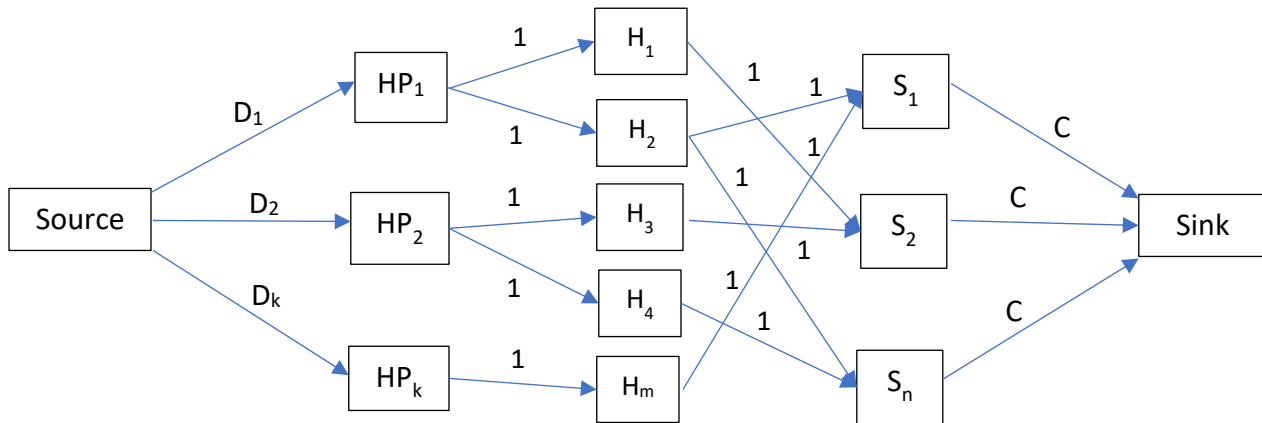


- b. First, we know that we have a solution if the max flow of the network is equal to the number of clients. This means that each client was covered by a base station. We will know which clients are assigned to which base station by following the flow through each client. If the edge between a client and base station is at capacity then, we have an assignment.

## 2. IT Department Holiday Scheduling

- a. 1. The max flow of the network below solves the problem by assigning each supervisor to a holiday of their choice. This is done by having capacity of 1 on the edges leaving each HP vertex to ensure that each holiday gets one assignment. The number of edges that leave an HP vertex is equal to its  $D_j$  to ensure that each holiday is accounted for. Then, the holidays are mapped to the supervisors that are willing to work that holiday with an edge capacity of 1. Finally, each supervisor has an edge of capacity  $C$ , to ensure that no supervisor covers more than  $C$  holiday days as stated by the second constraint.

2. There is no solution if the max flow does not equal the  $m$  (the total amount of holidays). This would mean that one or more holidays were not covered by a supervisor.
3. Once a solution is found, we can find the assignments by following the flow network and seeing if an edge from a holiday to a supervisor is at its capacity, then we have an assignment. This can be repeated for each holiday to see who was assigned for that day.



- b. 1. The max flow of the network below solves the problem by assigning each supervisor to a holiday of their choice and having each supervisor only work one holiday from a given holiday period. This is done by having capacity of 1 on the edges leaving each HP vertex to each supervisor that choose to take an assignment from that period. This ensures that each supervisor gets only one assignment from a holiday period. The number of edges that leave an HP vertex is equal to its  $D_j$  to ensure that each holiday is accounted for. Then, the holidays are mapped to the supervisors that are willing to work that holiday with an edge capacity of 1. Finally, each holiday has an edge of capacity  $C$ , to ensure that no holiday is left unassigned.
2. There is no solution if the max flow does not equal the  $m$  (the total amount of holidays). This would mean that one or more holidays were not covered by a supervisor. There is also no solution if a supervisor is assigned to two holidays of the same period.
3. Once a solution is found, we can find the assignments by following the flow network and seeing if an edge from a supervisor to a holiday is at its capacity, then we have an assignment. This can be repeated for each holiday to see who was assigned for that day.

