CS5800: Algorithms Spring 2018
Assignment 8.2

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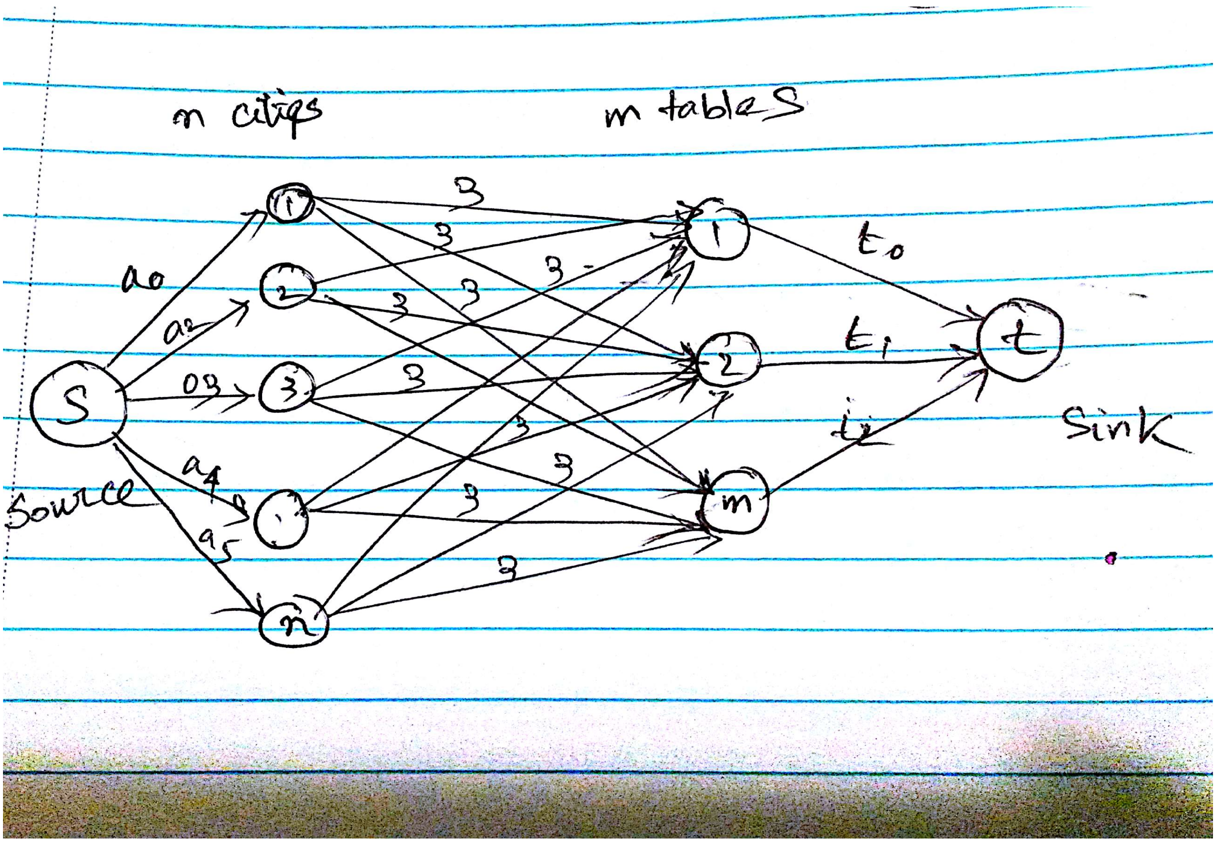
Algorithm: The given problem can be framed as max flow problem if we introduce a dummy source and sink node. Let s and t are artificial source and target node. Now, there are two sets of vertices.
One set indicates all the n different cities with a_i students from it i.e. $u_i : 1 <= i <= n$. The other set indicates m different tables with t_i capacity i.e. $v_j : 1 <= j <= m$
So, $V = (s, t) + (u_i : 1 <= i <= n) + (v_j : 1 <= j <= m)$
and $E = ((s, u_i) : 1 <= i <= n) + ((u_i, v_j) : 1 <= i <= n, 1 <= j <= m) + ((v_j, t) : 1 <= j <= m)$
If we connect source with all u_i and sink with all v_j, it becomes a bipartte graph.
Now to ensure no more than 3 students from same city sit on same table, we give (u_i, v_j) edges a capacity of 3. Also, capacity of edges from source to u_i will be a_i and capacity of edges from v_j to sink will be t_j
Now we can apply max flow problem which will give us assignment of students to table where no more than three students from city can sit on a table. Please find attached the graph for this problem.



Analysis: Time complexity for Ford Fulkerson Algorithm is $O(VE^2)$ if we use BFS to pick the path (Edmonds-Karp Algorithm) Space complexity: $O(V^2)$ to store in adjacency matrix.