Circulation with Demands

- Instead of Flow Conservation property, we replace it with **Demand Constraint** property
- Incoming(V) – Outgoing(V) = Demand(V)
- A demand constraint diagram does not have source/target vertex
- The question is whether the demand constraint diagram is feasible or not

Steps for checking whether the demand constraint diagram is feasible or not

1) Create source vertex

2) Link source vertex to all vertices with negative demands

3) The edges of the source vertex to vertices with negative demands should have the weight equivalent to the demand itself

4) Create target vertex

5) Link all vertices with positive demands to target vertex

6) The edges of the vertices with positive demands to target vertex should have the weight equivalent to the demand itself

7) Run Ford-Fulkerson as usual

How to know if the demand constraint diagram is feasible?

1) The flow flowing from the source vertex is equivalent to the flow flowing into the target vertex

2) The flow flowing out from the source vertex and into the target vertex must be maximised(flow == capacity)

The trick to identifying whether a demand constraint diagram is not feasible quickly

- If the sum of the demand of all vertices are not equivalent to 0, GUARANTEED to be not feasible!
- If the sum of the demand of all vertices are equivalent to 0, NOT GUARANTEED to be feasible, you still need to check using the steps as mentioned above

The inclusion of lower-bounds

- Instead of 0 <= Flow <= Capacity, each edge is now lower-bounds <= Flow <= Capacity
- Only one layer of preprocessing, and then same steps as circulation with demands without any lower bounds
- Transform the diagram by adjusting the demand of each vertex and the weight of the edges are now (capacity – lower bounds)
- Once diagram is transformed, use the transformed diagram and repeat as usual in what was discussed previously to find out whether the demand constraint diagram is feasible or not