ALM 3

DESIGN AND ANALYSIS OF ALGORITHMS

(Q) What is the Ford Fulkerson Algorithm? How does it work in solving network flow problems? Prepare a case study and submit in LMS.

Sol. **Introduction to the Ford-Fulkerson Algorithm:-**

The Ford-Fulkerson Algorithm is a method used to compute the maximum flow in a flow network. Developed by L.R. Ford, Jr. and D.R. Fulkerson in 1956, this algorithm plays a fundamental role in solving network flow problems and has applications in various fields such as computer networking, transportation, and logistics. The algorithm repeatedly finds augmenting paths in a residual graph to push flow from a source node to a sink node, aiming to maximize the total flow.

How the Ford-Fulkerson Algorithm Works

1. Initialize Flow: Start with an initial flow of 0 across all edges.
2. Identify Augmenting Paths.
3. Update Residual Capacities
4. Iterate Until No Augmenting Paths
5. Result

Case Study: Application of the Ford-Fulkerson Algorithm in a Transportation Network

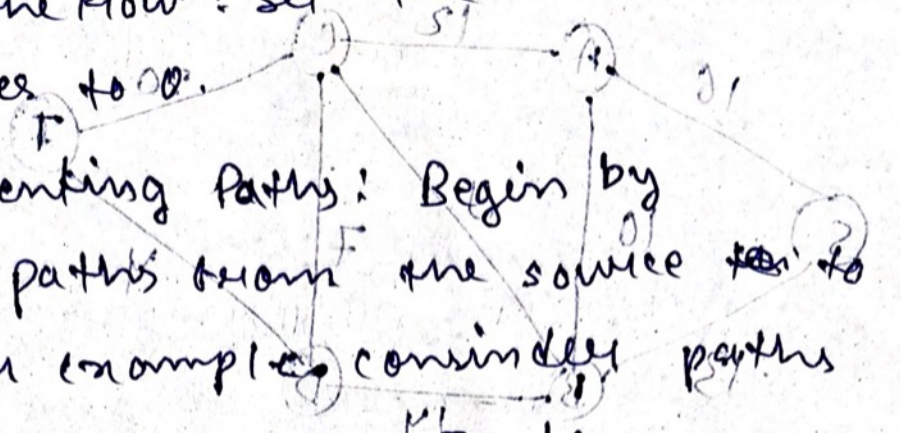
Problem Statement: Imagine a transportation network connecting several warehouses (nodes) across a city, where goods need to be transported from a central warehouse (source) to a distribution center (sink). Each route (edge) between warehouses has a certain capacity limit.

Network Setup:

- Source Node (S): central warehouse
- Sink Node (T): Distribution center
- Intermediate Nodes: Warehouses
- Edge Capacities: Maximum transport capacity of each route.

Applying Ford - Fulkerson Algorithm:

1. Initialize the Flow: Set the initial flow for all routes to 0.



2. Find Augmenting Paths: Begin by identifying paths from the source to the sink. For example, consider paths like $S \rightarrow A \rightarrow T$, $S \rightarrow B \rightarrow T$, etc.

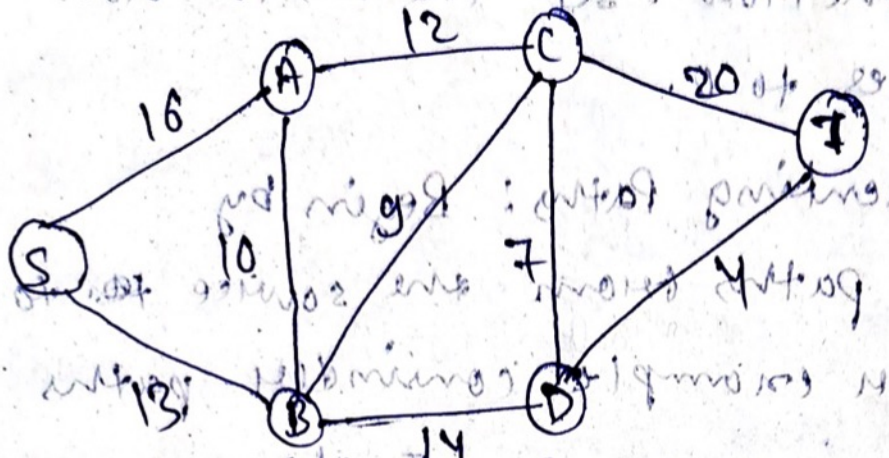
3. Augment Flow.

4. Update Residual Graph.

5. Repeat Until Maximum Flow.

Result and Insights:- The final flow obtained represents the maximum goods that can be transported daily between the central warehouse and the distribution centers.

Network Flow Diagram



Calculation

1. Initial Augmenting path
   - path : S → A → C → T
   - Minimum capacity in this path is 12
     (since S → A = 16, A → C = 12, C → T = 20)
   - Flow added : 12
2. Update Residual network
   - Adjust capacity along S → A → C → T by reducing each edge by 12
3) Next Augmenting path
   - path : S → B → D → T
   - minimum capacity : 4 (since S → B = 13, B → D = 14, D → T = 4)
   - Flow added : 4

4) Update Residual Network :
   - continue adjusting the capacities.