

Network Flow Algorithms

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1. Definition

- Algorithms that determine the maximum possible flow through a network (represented as a graph with capacities on edges) from a source node to a sink node.

2. Max-Flow Min-Cut Theorem

- The maximum flow through a network equals the capacity of the minimum cut (the smallest set of edges that, if removed, disconnects the source from the sink).

3. Ford-Fulkerson Method

- Repeatedly finds augmenting paths from source to sink and increases flow along them until no more augmenting paths exist.

4. Edmonds-Karp Algorithm

- An implementation of Ford-Fulkerson using breadth-first search to find augmenting paths, guaranteeing polynomial time complexity.

5. Applications

- Modeling transportation networks, telecommunications bandwidth allocation, bipartite matching problems (e.g., job assignment), and image segmentation.

6. Why It Matters

- Network flow provides a powerful, general framework for solving a wide range of optimization problems beyond literal "flow" scenarios.