Choice of Search Strategy for Finding an Augmenting Path

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Problem Statement

For finding an augmenting path in a graph, should Breadth First Search (BFS) or Depth First Search (DFS) be applied? Justify your answer.

Answer

An **augmenting path** is a path from the source to the sink in the residual graph such that all edges on the path have positive residual capacity. Augmenting flow along this path increases the total flow of the network.

Justification

Why Breadth First Search (BFS) is Preferred

Breadth First Search (BFS) is preferred for finding augmenting paths because it always finds the **shortest augmenting path** (in terms of number of edges). This property is used in the **Edmonds–Karp algorithm**, a well-known implementation of the Ford–Fulkerson method.

Using BFS ensures:

- Selection of the shortest augmenting path
- Polynomial time complexity
- Faster and more stable convergence to the maximum flow

Why Depth First Search (DFS) is Not Ideal

Depth First Search (DFS) may choose long or inefficient augmenting paths, which can:

- Lead to repeated cancellation of previous flows
- Cause poor performance or exponential running time in worst cases

Hence, DFS does not guarantee an efficient solution for finding augmenting paths.

Conclusion

Breadth First Search (BFS) should be applied to find augmenting paths.

BFS guarantees the shortest augmenting path and ensures efficient and reliable performance of maximum flow algorithms.