BFS and DFS

Ali Akbari

June 2025

Breadth-First Search Example

- **Problem**: Navigate maze from room A to D: A→B, A→C, B→D, C→D.
- Explore all nodes at current distance before moving farther.
- **Step-by-Step**:
  1. Start: Enqueue A.
  2. Dequeue A, visit B, C, enqueue B, C.
  3. Dequeue B, visit D, enqueue D.
  4. Dequeue C, D found.

Breadth-First Search

- Uses queue to explore nodes level by level.
- Guarantees shortest path in unweighted graphs.
- **Time Complexity**: $O(V + E)$, where V is vertices, E is edges.
- **Space Complexity**: $O(V)$.

Depth-First Search Example

- **Problem**: Same maze, explore deeply before backtracking.
- **Step-by-Step**:
  1. Start at A, visit B.
  2. From B, visit D (found).
  3. Backtrack to A, visit C, then D (visited).

Depth-First Search

- Explores as far as possible along a path, backtracks.
- Uses recursion or stack.
- **Time Complexity**: $O(V + E)$.
- **Space Complexity**: $O(V)$.