

Number of Provinces

● MEDIUM

■ Introduction

Given an adjacency MATRIX (not list), find how many connected components exist. Cities in the same connected component form one "province." This is a classic connected components problem — solved with DFS/BFS or Union-Find.

■ Core Intuition

Key Insight

- Input is an $n \times n$ adjacency matrix. `isConnected[i][j]=1` means city i and j are directly connected.
- A province = a connected component of cities.
- Algorithm: iterate over all cities. For each unvisited city, do DFS/BFS to mark all reachable cities as visited. Increment province count.
- Each DFS/BFS call discovers one complete province.

■ Java Implementation

Java

```
class Solution {
    public int findCircleNum(int[][] isConnected) {
        int n = isConnected.length;
        boolean[] visited = new boolean[n];
        int provinces = 0;

        for (int i = 0; i < n; i++) {
            if (!visited[i]) {
                dfs(isConnected, visited, i);
                provinces++; // Found a new province
            }
        }

        return provinces;
    }

    private void dfs(int[][] grid, boolean[] visited, int city) {
        visited[city] = true;

        for (int other = 0; other < grid.length; other++) {
```

■ Time & Space Complexity

Case	Time	Space	Why
DFS	$O(n^2)$	$O(n)$	Check every cell of $n \times n$ matrix; visited array $O(n)$
Union-Find	$O(n^2)$	$O(n)$	Same matrix scan; union operations nearly $O(1)$ each

Common Mistakes

Watch Out

- Adjacency MATRIX input (not list) — iterate j from 0 to n for neighbors.
- isConnected[i][i] = 1 (self-loop) — skip when i == j or handle gracefully.
- Forgetting to check !visited before DFS — avoid re-entering visited cities.

■ Practice Problems

Case	Time	Space	Why
Medium	LC 547	Number of Provinces	Direct application
Medium	LC 200	Number of Islands	Grid version
Medium	LC 684	Redundant Connection	Union-Find cycle detection
Hard	LC 827	Making a Large Island	Connected components + merge

■ Mental Model

Remember Forever

- "Each unvisited node is the start of a new island (province). DFS from it marks the entire island. Count how many times you start a new DFS = number of provinces."