Problem 3 : Risk

Problem Link:

https://onlinejudge.org/index.php?option=com_onlinejudge&Itemid=

8&page=show_problem&pr oblem=508

1. Problem Statement

You are given the map of a *Risk*-like board game consisting of 20 countries, numbered 1 to 20.
Each test set describes all borders between these countries. A border is bidirectional, and the input format lists only borders where I < J, so each border appears exactly once.

For each test set:

- Lines 1 through 19 describe borders.
  Line *i* begins with an integer *X*, meaning country *i* borders *X* countries numbered greater than *i*.
  The next *X* integers list those neighboring countries.
- Line 20 contains an integer N: the number of conquest queries.
- The next N lines each contain integers A B, representing a starting country *A* and a destination country *B*.

Your task:

For each query *(A, B)*, compute the minimum number of countries that must be conquered, including the destination country, when traveling from A to B.
This is equivalent to the shortest path length between A and B in the graph.

2. Hint

Treat the map as a small, fixed-size unweighted graph with 20 nodes.
The task for each query is equivalent to finding the minimum number of edges between two nodes.
Since all edges have equal weight, Breadth-First Search (BFS) gives the shortest path distance efficiently and reliably.
Only one BFS per query is needed because the graph is tiny.

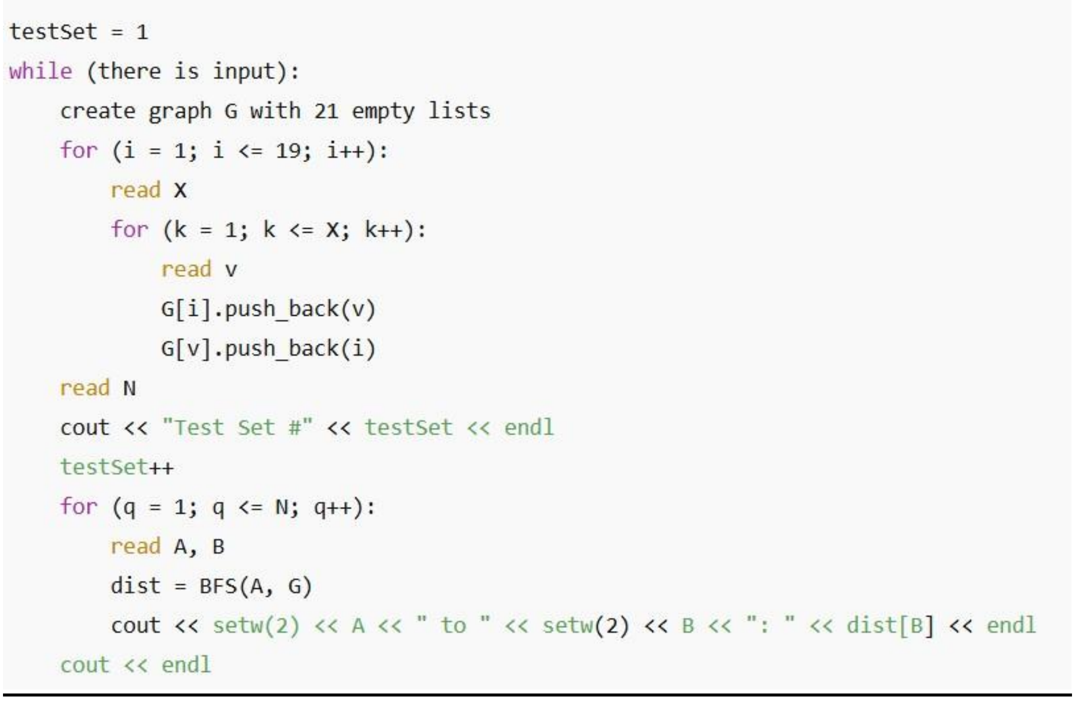
3. Improved Solution Approach

1. **Graph Construction** ○ Read 19 lines describing higher-numbered neighbors. ○ For each listed connection (i, v), insert edges in both directions into the adjacency list.

- This produces a complete undirected graph of the board.

2. **Shortest-Path Computation**
    - For each query (A, B):
        - Initialize a distance array with −1.
        - Run BFS from A, updating distances as nodes are reached.
        - Once B is assigned a distance, stop the BFS.
        - The distance value equals the minimum number of countries that must be conquered.
3. **Output Formatting**
    - Follow the exact output format: A to B: distance o Align numbers using fixed-width formatting rules as in the sample output.
    - Print a blank line after finishing all queries in a test set.

Pseudocode



```
testSet = 1
while (there is input):
    create graph G with 21 empty lists
    for (i = 1; i <= 19; i++):
        read X
        for (k = 1; k <= X; k++):
            read v
            G[i].push_back(v)
            G[v].push_back(i)
    read N
    cout << "Test Set #" << testSet << endl
    testSet++
    for (q = 1; q <= N; q++):
        read A, B
        dist = BFS(A, G)
        cout << setw(2) << A << " to " << setw(2) << B << ": " << dist[B] << endl
    cout << endl
```

Implementation Link:

https://github.com/TasnimaSultana/Algo_Lab_Final/blob/main/BFS/Risk/Risk.cpp