

Project: Discrete Structures (CS1005)

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1. Function Specifications

Correctness Type:

All functions implemented below demonstrate Total Correctness.

1. isWalk(string seq[], int len)

- **Pre-condition:** seq is an array of strings containing city names, and len is a positive integer representing the number of cities. The global graph adjacency matrix is initialized.
- **Post-condition:** Returns true if there is an edge in graph between every consecutive pair of cities (seq[i], seq[i+1]) for $0 \leq i < \text{len}-1$. Returns false if $\text{len} \leq 1$ or if any edge is missing.

2. isTrail(string seq[], int len)

- **Pre-condition:** Same as isWalk.
- **Post-condition:** Returns true if the sequence is a Walk AND no edge (u, v) is traversed more than once. Since the graph is undirected, an edge from A to B is considered the same as B to A.

3. isPath(string seq[], int len)

- **Pre-condition:** Same as isWalk.
- **Post-condition:** Returns true if the sequence is a Walk AND all vertices (cities) in the sequence are distinct (no city appears more than once).

4. isClosedWalk(string seq[], int len)

- **Pre-condition:** Same as isWalk.
- **Post-condition:** Returns true if the sequence is a Walk AND the starting vertex seq[0] is identical to the ending vertex seq[len-1].

5. isCircuit(string seq[], int len)

- **Pre-condition:** Same as isWalk.
- **Post-condition:** Returns true if the sequence is a Closed Walk AND it satisfies the condition of a Trail (no repeated edges).

6. isSimpleCircuit(string seq[], int len)

- **Pre-condition:** Same as isWalk.
- **Post-condition:** Returns true if the sequence is a Closed Walk AND all vertices are distinct, with the exception that the first and last vertices are the same. It ensures no internal vertex is repeated.

2. Test Cases and Output Samples

The following 5 test cases were executed:

Test Case 1:

- **Input:** ISLAMABAD->RAWALPINDI->SIALKOT
- **Output:**
 - Path: Yes
 - Walk: Yes
 - Trail: Yes
 - Closed Walk: No
 - Circuit: No
 - Simple Circuit: No

Test Case 2:

- **Input:** ISLAMABAD->RAWALPINDI->LAHORE->ISLAMABAD
- **Output:**
 - Path: No
 - Walk: Yes
 - Trail: Yes
 - Closed Walk: Yes
 - Circuit: Yes
 - Simple Circuit: Yes

Test Case 3:

- **Input:** LAHORE->ISLAMABAD->RAWALPINDI->LAHORE->FAISALABAD->BAHAWALPUR->GUJRANWALA->LAHORE
- **Output:**
 - Path: No
 - Walk: Yes
 - Trail: Yes
 - Closed Walk: Yes
 - Circuit: Yes

- Simple Circuit: No

Test Case 4:

- **Input:** ISLAMABAD->RAWALPINDI->ISLAMABAD
- **Output:**
 - Path: No
 - Walk: Yes
 - Trail: No
 - Closed Walk: Yes
 - Circuit: No
 - Simple Circuit: Yes

Test Case 5:

- **Input:** ISLAMABAD->KARACHI
- **Output:**
 - Path: No
 - Walk: No
 - Trail: No
 - Closed Walk: No
 - Circuit: No
 - Simple Circuit: No