**DISCRETE STRUCTURES ASSIGNMENT**

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Section – L2

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Question Number 11

**Question:** Write a program that determines whether a path is a simple path, a circuit or a cycle.

**Answer:**

The following source code is used too check whether a simple path, circuit or cycle is present in the inputted graph.

1. **Circuit**: Vertices may repeat. Edges cannot repeat (Closed)
2. **Path**: Vertices cannot repeat. Edges cannot repeat (Open)
3. **Cycle**: Vertices cannot repeat. Edges cannot repeat (Closed)

[For cycle detection in undirected graphs.](https://www.geeksforgeeks.org/union-find/) The time complexity of the union-find algorithm is O(ELogV). Like directed graphs, we can use [DFS](https://www.geeksforgeeks.org/depth-first-traversal-for-a-graph/)to detect cycle in an undirected graph in O(V+E) time. We do a DFS traversal of the given graph. For every visited vertex ‘v’, if there is an adjacent ‘u’ such that u is already visited and u is not parent of v, then there is a cycle in graph. If we don’t find such an adjacent for any vertex, we say that there is no cycle. The assumption of this approach is that there are no parallel edges between any two vertices.

Each time we visit a vertex v, we walk through two unvisited edges with one end point as v. Therefore, all middle vertices in Path must have even degree.

For Cycle, any vertex can be middle vertex, therefore all vertices must have even degree.

The solution has several applications, some of them are:

1. Data Mining.
2. GSM Mobile Phone Networks.
3. Web Designing
4. Structural covalently bonded compounds.

**Real-Life Application: Data Mining**

Data mining is process of perceiving required information from huge data with the help of various methods. Mostly the data we deal with in data science can be shaped as graphs. These graphs can be mined utilizing known algorithms and various techniques in graph theory to understand them in better way, e.g. in social networks every person in the network could be supposed as a vertex and any connection between them is supposed as an edge. Any problem related to logistics could be modelled as a network. Graph is captivating model of data backed with a strong theory and a set of quality algorithms to solve related problems.

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