

Module reflection

Graphs, trees and spanning trees

Graphs

- ✓ Vertices, or nodes, and edges, or the links connecting vertices, make up mathematical structures called graphs.
- ✓ They might be undirected, meaning that the edges are not directed, or directed, meaning that the edges have a definite direction.
- ✓ Several data structures, including adjacency lists, adjacency matrices, and edge lists, can be used to represent graphs.

Trees

- ✓ Each pair of vertices in a tree is connected by precisely one path, making them an acyclic type of graph devoid of cycles.
- ✓ One vertex is identified as the root of a tree, and there is only one path connecting any two vertices.
- ✓ Binary trees have a maximum of two offspring per node, while n-ary trees have a maximum of n children per node.

Spanning Trees

- ✓ In order to discover the least expensive network that connects every node, spanning trees are employed in network design.
- ✓ A subgraph having all of the original graph's vertices and the fewest possible edges is called a spanning tree of a connected graph.
- ✓ Algorithms such as BFS or DFS for unweighted graphs and Kruskal's or Prim's for weighted graphs can be used to find a spanning tree.

Important Ideas

- ✓ A graph that has a path connecting each pair of vertices is said to be connected.
 - ✓ An uncycled graph is known as an acyclic graph.
 - ✓ A path known as an Euler path makes exactly one pass across each edge of a graph.
 - ✓ An Euler circuit is one that begins at the starting vertex and travels through each edge of a graph exactly once.
 - ✓ Tree with a specific root node is called a "rooted tree."
 - ✓ A binary tree is one in which there are no more than two offspring per node.
- In many disciplines, such as computer science, mathematics, and engineering, where the topology and connectivity of networks or structures need to be examined or depicted, an understanding of basic planar graphs and their characteristics is essential.

Euler Trails and Euler circuits

Eulerian Graphs

- ✓ Any graph with an Eulerian trail or circuit is said to be an Eulerian graph.
- ✓ A path that crosses every edge of the graph exactly once is known as an Eulerian trail.
- ✓ A circuit that visits every edge of the graph exactly once before returning to the starting vertex is known as an Eulerian circuit.

Euler's Theorem

- ✓ According to Euler's theorem, a connected graph only contains an Eulerian circuit if each vertex has an even degree.
- ✓ If and only if a connected network contains exactly two vertices with odd degrees, it is said to have an Eulerian trail.

Eulerian Trails and Circuits

- ✓ A technique for locating Eulerian trails and circuits in graphs is Fleury's Algorithm. At each phase, it chooses edges, making sure not to disconnect the graph until every edge has been explored.
 - ✓ A powerful approach for locating Eulerian circuits in graphs is Hierholzer's approach. It assembles the circuit by combining cycles.
- In graph theory, an understanding of Eulerian trails and circuits is crucial, and it has real-world implications in computer science, transportation engineering, and telecommunications, among other areas. These ideas support the analysis of network topology and connectivity as well as the resolution of routing and circuit design optimization issues.