



THE UNIVERSITY  
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**ISLAMABAD  
CAMPUS**

## **Data Structure and Algorithms**

### **Lab Report**

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# Experiment # 7

## Data Structure - Graph

### Objective

The objectives of this lab session are to understand the basic and various operations on arrays in C++.

## 1 Theory

A set of items connected by edges. Each item is called a vertex or node. Formally, a graph is a set of vertices and a binary relation between vertices, adjacency.

### Graph

Graph is a non linear data structure, it contains a set of points known as nodes (or vertices) and set of links known as edges (or Arcs) which connects the vertices. A graph is defined as follows... Graph is a collection of vertices and arcs which connects vertices in the graph Graph is a collection of nodes and edges which connects nodes in the graph Generally, a graph  $G$  is represented as  $G = (V, E)$ , where  $V$  is set of vertices and  $E$  is set of edges.

### Example

The following is a graph with 5 vertices and 6 edges. This graph  $G$  can be defined as  $G = (V, E)$  Where  $V = A, B, C, D, E$  and  $E = (A, B), (A, C), (A, D), (B, D), (C, D), (B, E), (E, D)$ .

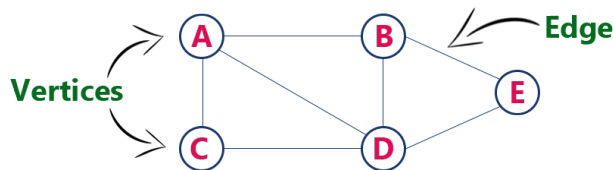


Figure : 1 Vertices and Edge

### Graph Terminology:-

We use the following terms in graph data structure...

**Vertex: -**

A individual data element of a graph is called as Vertex. Vertex is also known as node. In above example graph, A, B, C, D and E are known as vertices

**Edge: -**

An edge is a connecting link between two vertices. Edge is also known as Arc. An edge is represented as (startingVertex, endingVertex). For example, in above graph, the link between vertices A and B is represented as (A,B). In above example graph, there are 7 edges (i.e., (A,B), (A,C), (A,D), (B,D), (B,E), (C,D), (D,E)).

**Origin:-**

If an edge is directed, its first endpoint is said to be origin of it.

**Destination:-**

If an edge is directed, its first endpoint is said to be origin of it and the other endpoint is said to be the destination of the edge.

**Undirected Graph:-**

A graph with only undirected edges is said to be undirected graph.

**Directed Graph:-**

A graph with only directed edges is said to be directed graph.

**Parallel edges or Multiple edges:-**

If there are two undirected edges to have the same end vertices, and for two directed edges to have the same origin and the same destination. Such edges

are called parallel edges or multiple edges.

**Adjacent:-**

If there is an edge between vertices A and B then both A and B are said to be adjacent. In other words, Two vertices A and B are said to be adjacent if there is an edge whose end vertices are A and B.

**Path:-**

A path is a sequence of alternating vertices and edges that starts at a vertex and ends at a vertex such that each edge is incident to its predecessor and successor vertex.

**Tress and Graphs in Data Structures:-**

A tree data structure, like a graph, is a collection of nodes. There is a root node. The node can then have children nodes. The children nodes can have their own children nodes called grandchildren nodes. Graphs evolved from the field of mathematics. They are primarily used to describe a model that shows the route from one location to another location.

**Adjacent Nodes:-**

In this representation, graph can be represented using a matrix of size total number of vertices by total number of vertices. . In this matrix, rows and columns both represents vertices. This matrix is filled with either 1 or 0. Here, 1 represents there is an edge from row vertex to column vertex and 0 represents there is no edge from row vertex to column vertex.

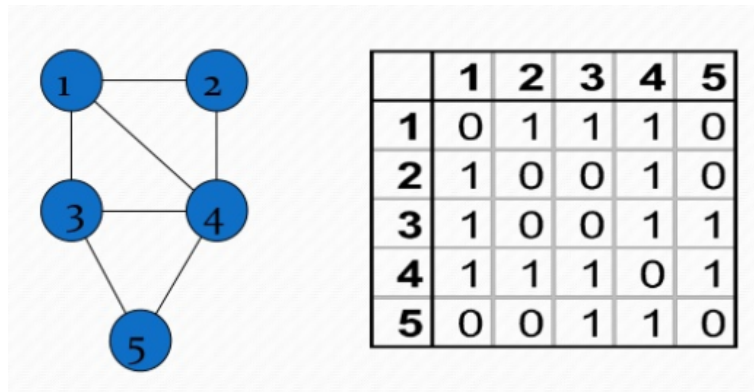


Figure : 1 Output Adjacent Nodes