Application of Graph Theory in Computer science using Data Structure

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ABSTRACT :
One of the important areas in mathematics in graph theory which used in structural model. This paper gives an data structure of the application of graph in heterogeneous field but mainly focus on the data structure that use graph theoretical concepts.

Graph data structure is a pictorial representation of a set of objects where some pairs of objects are connected by links. Interconnected objects are represented by paints termed as vertices and the link that connect the vertices and edges.

This paper is presented especially to project the idea of graph theory and to demon striate its objective and importance in data structure.

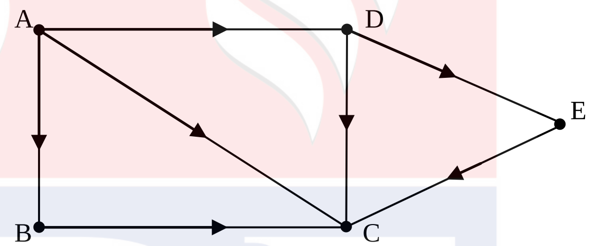
Keyword :
Graphs, Graph Drawing, Simple Graph, Multi Graph, Finite and Infinite Graph, Tree Graph, Spanning Trees Graph, Complete Graph.

Introduction :
This paper present some of the main terminology associated with the theory of graphs in data structure, we discuss the representation of graphs in memory and present various operations on them. In particular, we discuss the breadth – first search and the depth – first search of our graphs. Certain applications of graphs including topological sorting are also vovered.

1. Graphs :
A graph a consists of two things

- A set V of elements called nodes.
- A set E of edges such that each edges e in E is identified with a unique pair [u, v] of nodes in V denoted by e = [u, v]

1.1 Linked Represent of a Graph Theory :
The sequential representation of graph in memory. The representation of G by its adjacency matrix A – has a number of major drawbacks. First of it may be difficult to insert and delete nodes in G. this is because the size of a may need to be changed and the nodes may to be recorded. So there may be many, many changes in the matrix A.
The graph G in fig (a). The table in fig. (b) show each mode in G followed by the adjacency list. Which is list of an adjacent node. The fig. (c) show a schematic graph diagram of a linked representation of G in Memory.



Show Graph G
Fig (A)

Node	Adjacency List
A	B, C, D
B	C
C	
D	C, E
E	C

Adjacency List of G

The linked representation will contain two list node list and edge list the graph representation.

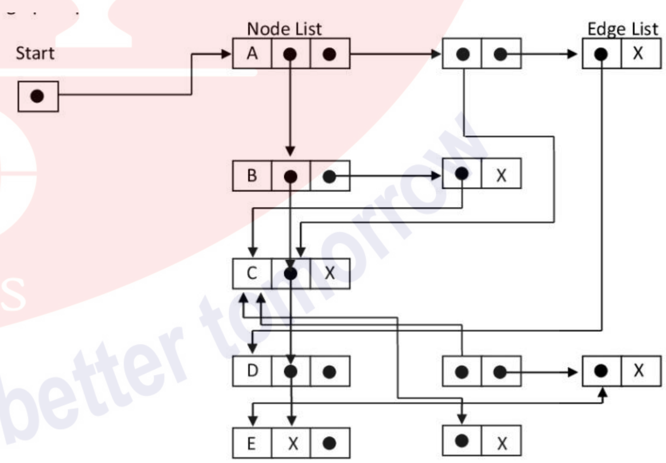


Fig. (B)

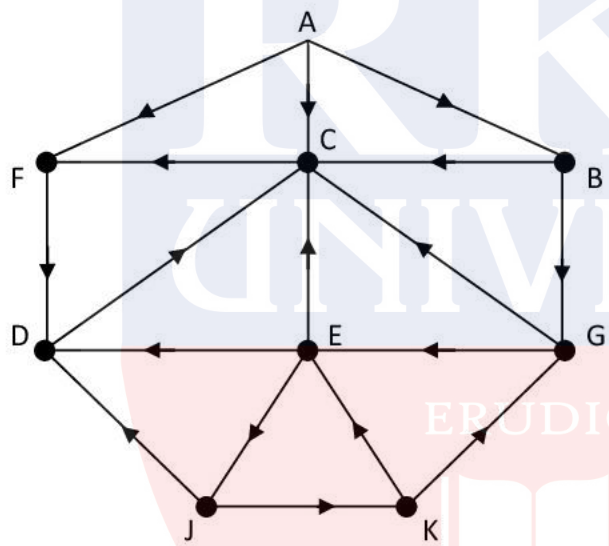
The graph representation here node will be the name of key value of the node; next will be a pointer to the next node in the list node and ADJ will be a pointer to first element in the adjacency list of the node. Which is maintained in the list

1.2 Data Structure traversing Graph:

Data structure using graph theory algorithms require one to systematically examine the nodes and edges of graph G. there are two standard ways that this is done. One way is called a breadth – first search. The breadth – first search will use a queue as an auxiliary structure to hold nodes for future processing and analogously. The depth – first search will use a staik.

Show fig. (e) suppose G representation the daily flights between cities of some airline and suppose we want to fly form city A ti city J with the minimum of stops.

We want the minimum path P from A to J.



Fig, (C)

Adjacency List		
A	:	F, C, B
B	:	G, C
C	:	F
D	:	C
E	:	D, C, J
F	:	D
G	:	C, E
J	:	D, K
K	:	E, G

The minimum path P can be found by using a breadth – first search beginning a city A and ending when J is encountered.

1.3 Data Structure Posets Topological Using Graph :

S is a graph such that each node V_i of S represents a task and each edge (u, v) means that the completion of the task u is a prerequisite for starting the task v. suppose such a graph S contains a cycle such as.

P = (u, v, w, u)

That we cannot begin v until completing u we cannot begin w until completing v and we cannot u until completing w. In this fig. (f) observe that s has no cycles. Thus s may be regarded as a partially order set there is a path from G to C, B < F and B < C. On the other hand B < A since there is no path from B to A.

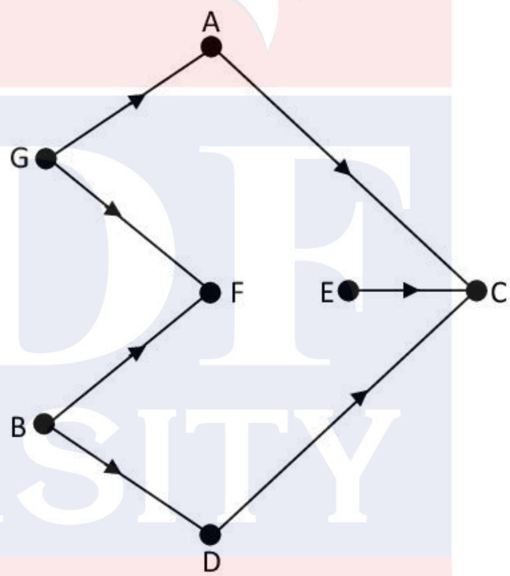


Fig. (D)

Adjacency List		
A	:	C
B	:	D, F
C	:	
D	:	C
E	:	C
F	:	
G	:	A, F

1.4 Stack and Queue Representation of Graph Theory :

All the algorithms we introduce will involve graph and it is our job to study how to represent them on computer. We begin by discussing some data structures that are commonly used to store information in a computer. The ward informally means an arrangement of objects. More formally a list consists of a number of elements each of which is a single field or is divided into several fields. Fields commonly represent vertices, edges or pointers in particular there are three types of lists that we use in common.

A stack is an ordered collection of items in which new items can be inserted and from which items can be deleted from one end called the top of the stack. We can insert and delete item from a stack so that stack is dynamic. That is constantly changing object. How does a stack change? The top of a stack is a single end. If we are adding new items we put them on the top. So that top of the stack move up wards similarly. When we remove an item from tee stack the top item will be deleted. So that the top of the stack moves downwards in figure (E), (b), (c), (d), (e), (f) and (g) are different stacks obtained from the stack given in fig. (a)

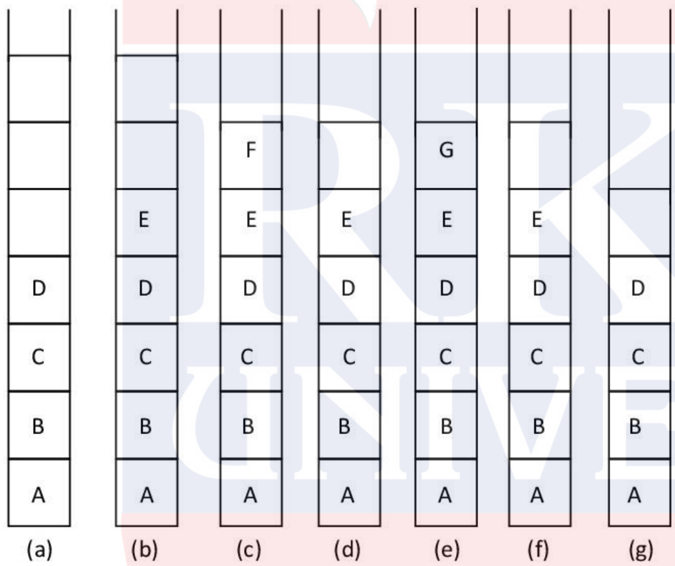


Fig. (E)

From the figure it is clear that we insert a new item. The stack expands and when an item is deleted stack shrinks also. The last element inserted into a stack is the first element deleted. The stack is called a last – in – first – out list. There are only two changes that can be down on a stack. They are nothing but push and pop. That is when an item is added to a stack. It is pushed on to the stack and when an item is removed it is popped from the stack.

A queue is an ordered collection of items from which items may be deleted from one end and items may be inserted at the other end in see fig. (F)

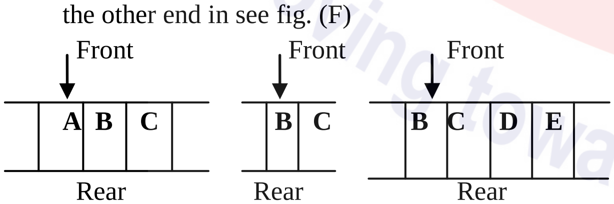


Fig. (F)

In a queue the first element inserted into a queue is the first element to be removed. Thus queue is known as a first – in – first – out list that is it similar to a queue in real life.

A linked list is a sequence of vertices and the sequential order is maintained by pointers. These are suitable for applications that require sequential storage. There are applications that have unpredictable storage requirements and extensive manipulation of the stored data. Such applications need liked allocation method of storage for effective use of computer time and memory. The entire linked list is assessed from an external edge list directs to the first vertex in the list.

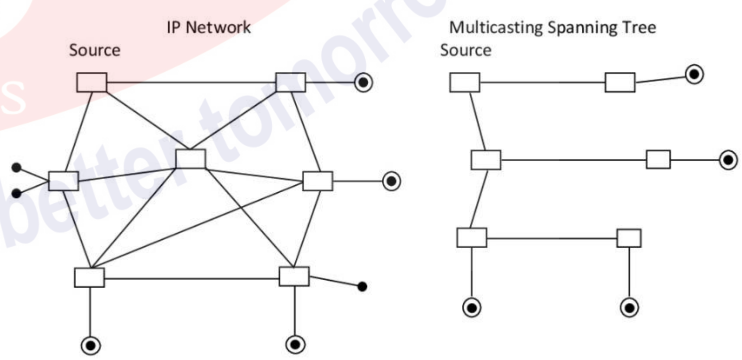
Using these definitions one can represent graph in a computer.

1.5 Spanning Trees use in Data Networking :

Spanning trees play an important role in multicasting over internet protocol (IP) networks to send from a source computer to multi play receiving computers. Each of which is a sub network data could be sent separately to each computer. This type of networking called unicasting, is inefficient because many copies of the same data are transmitted over the network to make the transmission of data to multiple receiving computers more efficient. IP multicasting is used with IP multicasting a computer sends a single cope of data over the network and as data reached intermediate routers. The data are forwarded to one or more other routers so that ultimately all receiving computers in their various sub networks receive these data.

For data to reach receiving computers as quickly as possible there should be no loop in the path that data take through the network. That is once data have reached a particular router, data should never return to this router. To avoid loops the multicast routers use network algorithms to construct a spanning tree in the graph that has the multicast source the routers and the sub networks containing receiving computer as vertices with edges representing the links between computer and routers. The root of this spanning tree is the multicast source. The sub networks containing receiving computer are leaves of the tree.

This is illustrated in fig. (G)



(a) Multicast Spanning Tree (b)
Fig. (G)

▭ Router
● Sub Network
◉ Sub Network with Receiving Station

1.6 Graph Theory use Seating Arrangement Problem :
Nine member of a new club meet each day for meeting at a round table. They decide to sit so that "Each member has different neighbors at each work. How many day can this arrangement last.
This situation can be represented a graph with nine vertices such that each vertex. Represents a member and an edge joining two vertices represent the relationship of sitting next to each other. The following fig. (H) shows two possible arrangements (1 2 3 4 5 6 7 8 9 1, 1 3 5 2 7 4 9 6 8 1) at the meeting table.

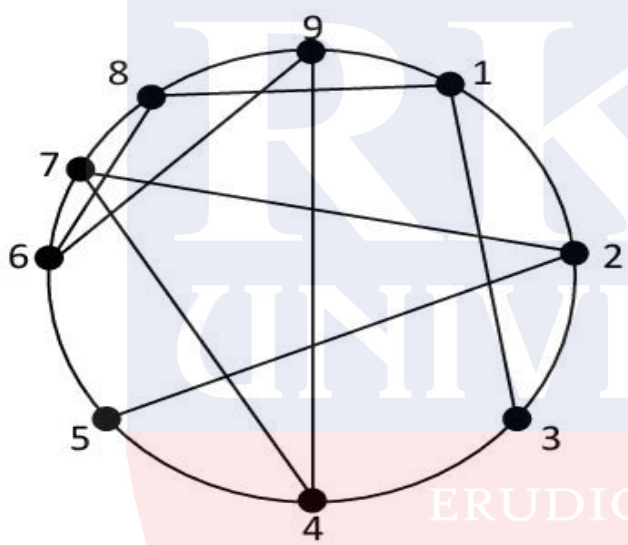


Fig. (H)

From this figure, we can observe that there are two possible seating arrangements, which are 1 2 3 4 5 6 7 8 9 1 and 1 3 5 2 7 4 9 6 8 1. It can be shown by graph theoretic considerations that there are only two more arrangements possible. Which are 1 5 7 3 9 2 8 4 6 1 and 1 7 9 5 8 3 6 2 4 1. In general for 'n' people the number of such possible arrangements is

=> $\frac{n-1}{2}$, if 'n' is odd

=> $\frac{n-1}{2}$, if 'n' is even

Conclusion :
The main aim of this paper is to present the importance of graph theoretical Idea in computer data structure. An computer data structure is especially to project the Idea of graph theory.

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