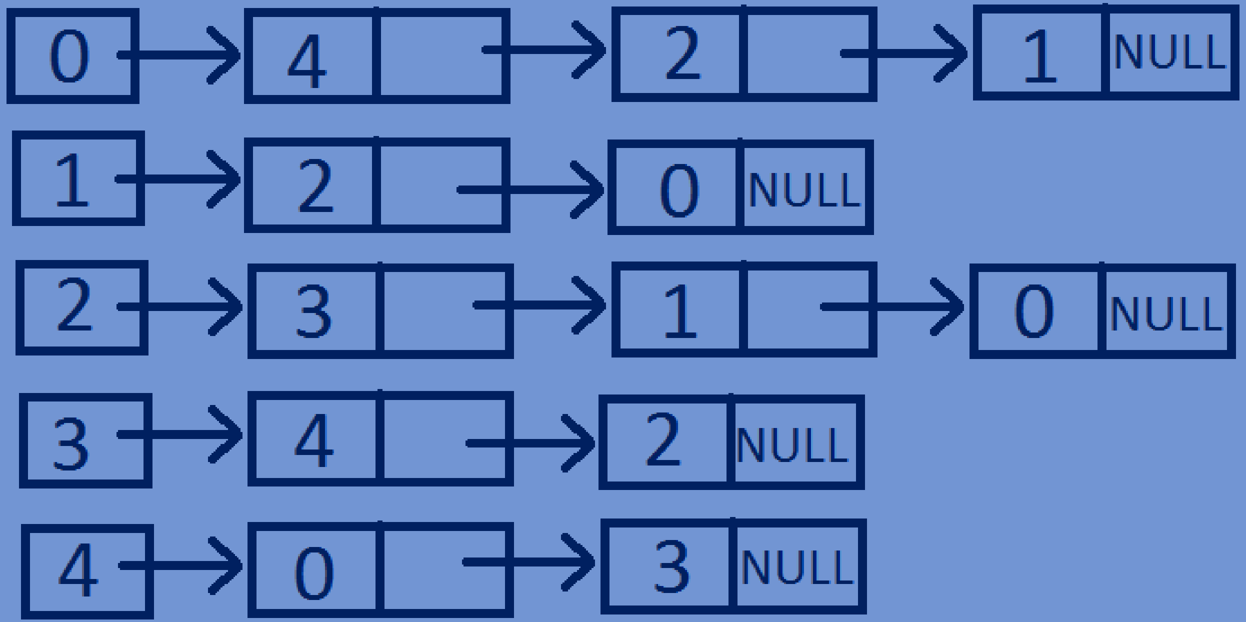
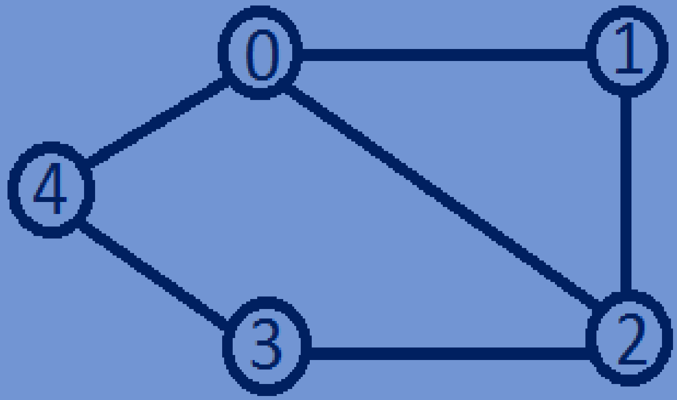
Data Structures

Implementation of an Undirected Graph using Adjacency List

Adjacency List representation of a Graph:

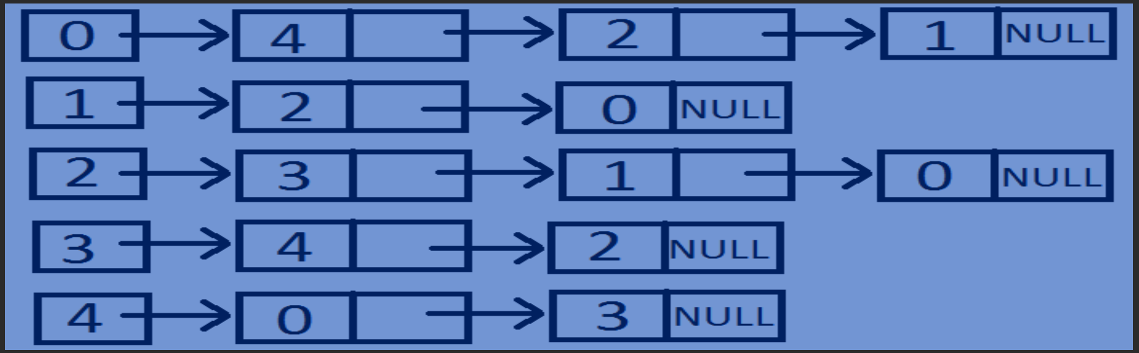
- Adjacency list is a collection of unordered lists that are used to represent a graph.
- Here we are going to use Array of linked lists for storing the adjacent nodes of Each node.
- The size of the array will be equal to the total no of vertices in the undirected graph.
- Here the index of the array represents the vertex of the graph.
- Consider our array is array[],now array[i] represents the linked list containing all the Vertices adjacent to i^th vertex.





Implementation of Undirected Graph using Adjacency List:

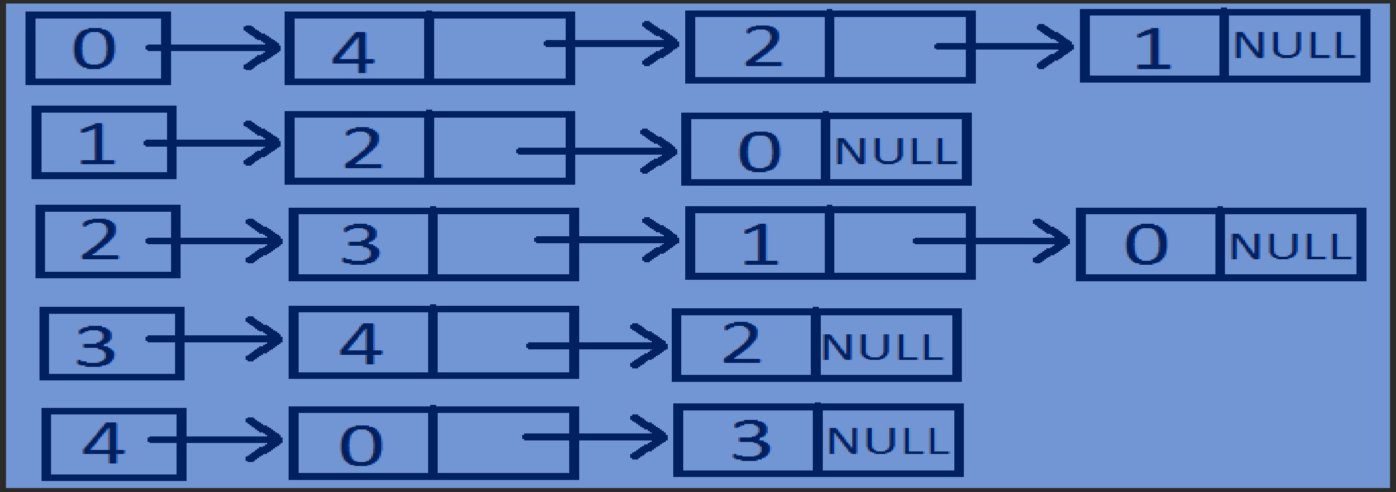
```
#include<stdio.h>
#include<stdlib.h>
//Structure for representing a NODE in the Adjacency List
typedef struct Node{
    int dest;
    int weight;
    struct Node *next;
}Node;
//structure for representing an adjacency liat
typedef struct List{
    Node *Head;
}List;
// A structure to represent a graph - here graph is an array of
Adjacency lists
// size of the array will be  equal to the number of vertices in
graph

typedef struct Graph{
    int totVertices;
```


$$\begin{tikzcd}
\boxed{0} \arrow[r] & \boxed{4 \mid } \arrow[r] & \boxed{2 \mid } \arrow[r] & \boxed{1 \mid \text{NULL}} \\
\boxed{1} \arrow[r] & \boxed{2 \mid } \arrow[r] & \boxed{0 \mid \text{NULL}} & \\
\boxed{2} \arrow[r] & \boxed{3 \mid } \arrow[r] & \boxed{1 \mid } \arrow[r] & \boxed{0 \mid \text{NULL}} \\
\boxed{3} \arrow[r] & \boxed{4 \mid } \arrow[r] & \boxed{2 \mid \text{NULL}} & \\
\boxed{4} \arrow[r] & \boxed{0 \mid } \arrow[r] & \boxed{3 \mid \text{NULL}} &
\end{tikzcd}$$

```c
    List *array;
}Graph;

//function To create a new node in the adjacency list
Node *createNewNode(int dest,int weight){
    Node *newnode=(Node*)malloc(sizeof(Node));
    newnode->dest=dest;
    newnode->weight=weight;
    newnode->next=NULL;
    return newnode;
}

//Function To creates a graph of n vertices
Graph *createGraph(int n){
    Graph *graph=(Graph*)malloc(sizeof(Graph));
    graph->totVertices=n;
    graph->array=(List*)malloc(n*sizeof(List));
    //Initialise each adjacency list as empty by making head as NULL
    for(int i=0;i<n;i++){
        graph->array[i].Head=NULL;
    }
    return graph;
```

```c
}
//function for Adding an edge to an undirected graph
void addedge(Graph *graph,int src,int dest,int weight){
    Node *newnode=createNewNode(dest,weight);
    newnode->next=graph->array[src].Head;
    graph->array[src].Head=newnode;

    newnode=createNewNode(src,weight);
    newnode->next=graph->array[dest].Head;
    graph->array[dest].Head=newnode;
}
//Function for printing Adjacency list corresponding to each vertex
void printGraph(Graph *graph){
    for(int i=0;i<graph->totVertices;i++){
        Node *Headnode=graph->array[i].Head;
        printf("connected vertices of vertex %d are:head",i);
        while(Headnode){
            printf("->%d",Headnode->dest);
            Headnode=Headnode->next;
        }
        printf("\n");
    }
```

```
}
//main function
int main(){
    int n=5;
    Graph *graph=createGraph(n);
    addedge(graph,0,1,2);
    addedge(graph,0,2,1);
    addedge(graph,1,2,3);
    addedge(graph,2,3,1);
    addedge(graph,3,4,5);
    addedge(graph,4,0,4);
    printGraph(graph);
}
```



Output

```
connected vertices of vertex 0 are:head->4->2->1
connected vertices of vertex 1 are:head->2->0
connected vertices of vertex 2 are:head->3->1->0
connected vertices of vertex 3 are:head->4->2
connected vertices of vertex 4 are:head->0->3
```