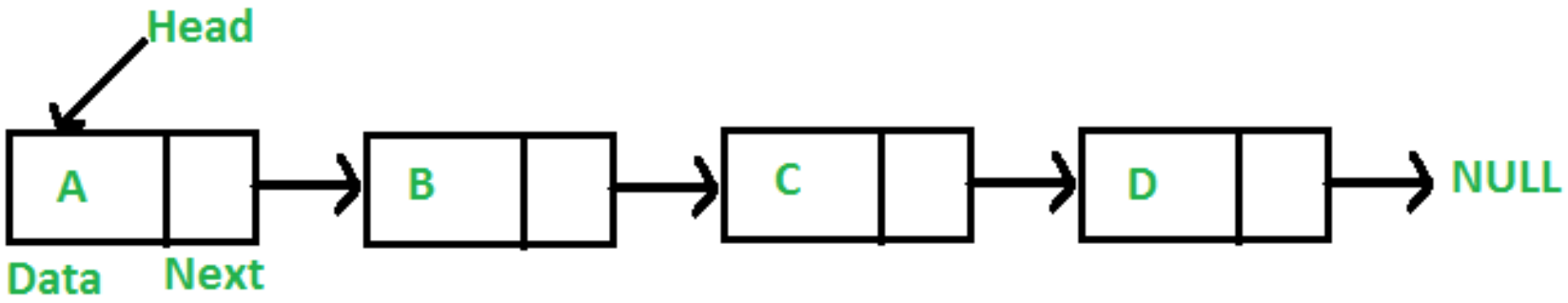
LINKED LIST

A linked list is a linear data structure, in which the elements are not stored at contiguous memory locations. The elements in a linked list are linked using pointers as shown in the below image:


Head
A
B
C
D
NULL
Data
Next

In simple words, a linked list consists of nodes where each node contains a data field and a reference(link) to the next node in the list.

TYPES

Singly Linked List

Circular Linked List

Doubly Linked List

INTRODUCTION

Like arrays, Linked List is a linear data structure. Unlike arrays, linked list elements are not stored at a contiguous location; the elements are linked using pointers.

Why Linked List?

Arrays can be used to store linear data of similar types, but arrays have the following limitations.

1) The size of the arrays is fixed: So we must know the upper limit on the number of elements in advance. Also, generally, the allocated memory is equal to the upper limit irrespective of the usage.

2) Inserting a new element in an array of elements is expensive because the room has to be created for the new elements and to create room existing elements have to be shifted.

For example, in a system, if we maintain a sorted list of IDs in an array id[].

id[] = [1000, 1010, 1050, 2000, 2040].

TYPES

And if we want to insert a new ID 1005, then to maintain the sorted order, we have to move all the elements after 1000 (excluding 1000).

Deletion is also expensive with arrays until unless some special techniques are used. For example, to delete 1010 in id[], everything after 1010 has to be moved.

TYPES

Advantages over arrays

1) Dynamic size

2) Ease of insertion/deletion

TYPES

Drawbacks:

1) Random access is not allowed. We have to access elements sequentially starting from the first node. So we cannot do binary search with linked lists efficiently with its default implementation. Read about it here.

2) Extra memory space for a pointer is required with each element of the list.

3) Not cache friendly. Since array elements are contiguous locations, there is locality of reference which is not there in case of linked lists.

TYPES

Representation:

A linked list is represented by a pointer to the first node of the linked list. The first node is called the head. If the linked list is empty, then the value of the head is NULL.

Each node in a list consists of at least two parts:

1) data

2) Pointer (Or Reference) to the next node

In C, we can represent a node using structures. Below is an example of a linked list node with integer data.

In Java or C#, LinkedList can be represented as a class and a Node as a separate class. The LinkedList class contains a reference of Node class type.

TYPES

```
class Node {
public:
    int data;
    Node* next;
};
```

Applications of Linked List

Implementation of stacks and queues

Implementation of graphs : Adjacency list representation of graphs is most popular which is uses linked list to store adjacent vertices.

Dynamic memory allocation : We use linked list of free blocks.

Maintaining directory of names

Performing arithmetic operations on long integers

Manipulation of polynomials by storing constants in the node of linked list

representing sparse matrices