STUDY ON LINKLIST

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***Abstract*-This paper address about the link list ,its types & operations on link list like creation, traversing, insertion, deletion, searching a node in link list.**

I. INTRODUCTION:

A link list is an ordered collection of finite homogeneous data elements called nodes where the linear order is maintained by means of links or pointers that is each pointer is divided into two parts: first contain the info of the element and the second part, called the link field contains the address of the next node in the list.

--We will be discussing about two type of link list:

- Singly link list.
- Doubly link list
- Singly Link List

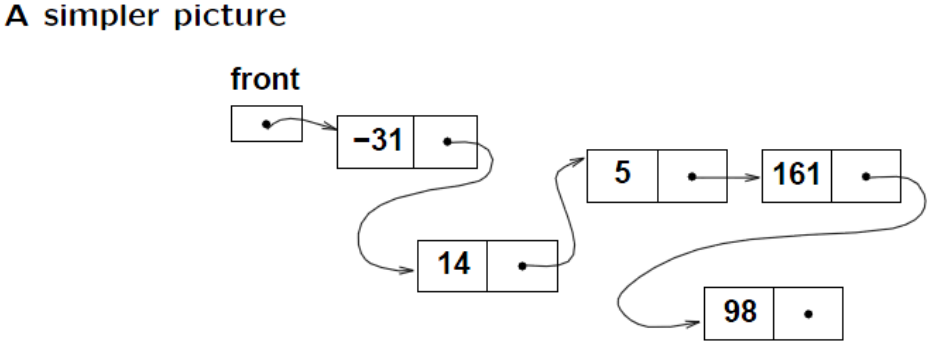
The principal benefit of a linked list over a conventional array is that the list elements can easily be inserted or removed without

reallocation or reorganization of the entire structure because the data items need not be stored contiguously in memory or on disk. Linked lists allow insertion and removal of nodes at any point in the list, and can do so with a constant number of operations if the link previous to the link being added or removed is maintained during list traversal.

Doubly linked list

Main article: Doubly linked list

In a **doubly linked list**, each node contains, besides



two links may be called **forward(s)** and **backwards**,

the next-node link, a second link field

or **next** and **prev** (**previous**).

pointing to the *previous* node in the sequence. The

an integer value, the link forward to the next node,

A doubly linked list whose nodes contain three fields:

and the link backward to the previous node

A technique known as XOR-linking allows a doubly linked list to be implemented using a single link field

ability to do bit operations on addresses, and therefore may not be available in some high-level

in each node. However, this technique requires the

languages.

- **Multiply linked list**

In a **multiply linked list**, each node contains two or more link fields, each

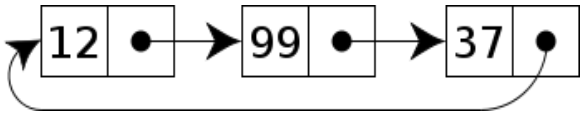
field being used to connect the same set of data records in a different order

(e.g., by name, by department, by date of birth, etc.). While doubly linked lists can be seen as special cases of multiply linked list, the fact that the two orders are opposite to each other leads to simpler and more efficient

algorithms, so they are usually treated as a separate case.

Circular list

In the last node of a list, the link field often contains a null reference, a special value used to indicate the lack of further nodes. A less common convention is to make it point to the first node of the list; in that case the list is said to be 'circular' or 'circularly linked'; otherwise it is said to be 'open' or 'linear'.



A circular linked list

In the case of a circular doubly linked list, the only change that occurs is that the end, or "tail", of the said list is linked back to the front, or "head", of the list and vice versa.

Sentinel Nodes

In some implementations, an extra **sentinel** or **dummy** node may be added before the first data record and/or after the last one. This convention simplifies and accelerates some list-handling algorithms, by ensuring that all links can be safely dereference and that every list (even one that contains no data elements) always has a "first" and "last" node.

- **Empty lists**

An empty list is a list that contains no data records. This is usually the same as saying that it has zero nodes. If sentinel nodes are being used, the list is usually said to be empty when it has only sentinel nodes.

- **Hash linking**

The link fields need not be physically part of the nodes. If the data records are stored in an array and referenced by their indices, the link field may be stored in a separate array with the same indices as the data records

.

Singly linked lists

- **Linearly linked lists**

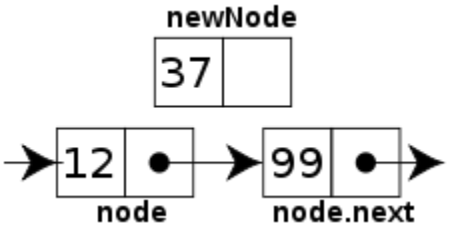
Our node data structure will have two fields. We also keep a variable *first Node* which always points to the first node in the list, or is *null* for an empty list.

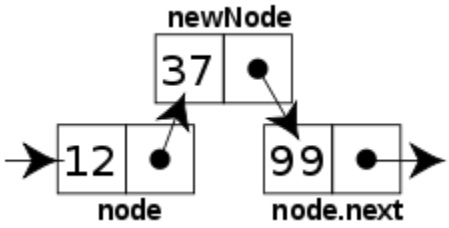
```
{
   data; // The data being stored in the node
   Node next // A reference to the next node, null for last node
}
record List
{
   Node firstNode // points to first node of list; null for empty list
}
```

Traversal of a singly linked list is simple, beginning at the first node and following each *next* link until we come to the end:

```
node := list.firstNode
while node not null
   (do something with node.data)
   node := node.next
```

The following code inserts a node after an existing node in a singly linked list. The diagram shows how it works. Inserting a node before an existing one cannot be done directly; instead, one must keep track of the previous node and insert a node after it.



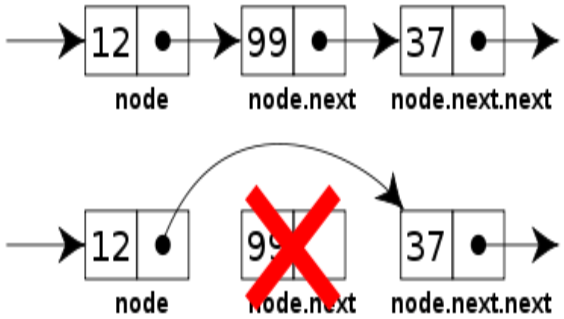



```
function insertAfter(Node node, Node newNode) // insert newNode after node
    newNode.next := node.next
    node.next    := newNode
```

```
function insertBeginning(List list, Node newNode) // insert node before current first node
    newNode.next   := list.firstNode
    list.firstNode := newNode
```

Inserting at the beginning of the list requires a separate function. This requires updating *firstNode*.

Similarly, we have functions for removing the node *after* a given node, and for removing a node from the beginning of the list. The diagram demonstrates the former. To find and remove a particular node, one must again keep track of the previous element.




```
function removeAfter(Node node) // remove node past this one
    obsoleteNode := node.next
    node.next := node.next.next
```

```
function removeBeginning(List list) // remove first node
    obsoleteNode := list.firstNode
    list.firstNode := list.firstNode.next // point past deleted node
```

destroy obsoleteNode

- **Circularly linked list**

In a circularly linked list, all nodes are linked in a continuous circle, without using *null*. For lists with a front and a back (such as a queue) one stores a reference to the last node in the list. The *next* node Circularly linked lists can be either singly or doubly linked.

after the last node is the first node. Elements can be added to the back of the list and removed from the front in constant time.

Both types of circularly linked lists benefit from the ability to traverse the full list beginning at any given node. This often allows us to avoid storing *first Node* and *last Node*, although if the list may be empty we need a special representation for the empty list, such as a *last Node* variable which points to some

node in the list or is *null* if it's empty; we use such a *last Node* here. This representation significantly simplifies adding and removing nodes with a non-empty list, but empty lists are then a special case.

- ***Algorithms***

Assuming that *some Node* is some node in a non-empty circular singly linked list, this code iterates through that list starting with *some Node*:

```
function iterate(someNode)
  if someNode ≠ null
    node := someNode
    do
      do something with node.value
      node := node.next
    while node ≠ someNode
```

Notice that the test "**while** node ≠ someNode" must be at the end of the loop. If the test was moved to the beginning of the loop, the procedure would fail whenever the list had only one node.

This function inserts a node "newNode" into a circular linked list after a given node "node". If "node" is null, it assumes that the list is empty.

```
function insertAfter(Node node, Node newNode)
    if node = null
      newNode.next := newNode
```

```
else
  newNode.next := node.next
  node.next := newNode
```

- **Reference:**

1.) www.google.com

2.) http://en.wikipedia.org/wiki/Linked_list