Lecture # 3

Linked List

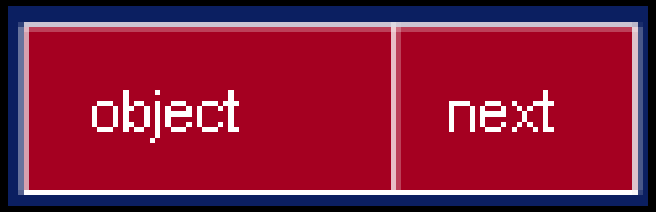
- Link List is a Data Structure in which elements are explicitly ordered, that is each item contains within itself the address of next item.

- The array implementation has the serious drawback and that is we must specify size at the construction time though it is simple and fast.

- Murphy's Law:
  - Construct an array with space for n = twice your estimate of largest collection
  - Tomorrow you will need n+1

Linked List

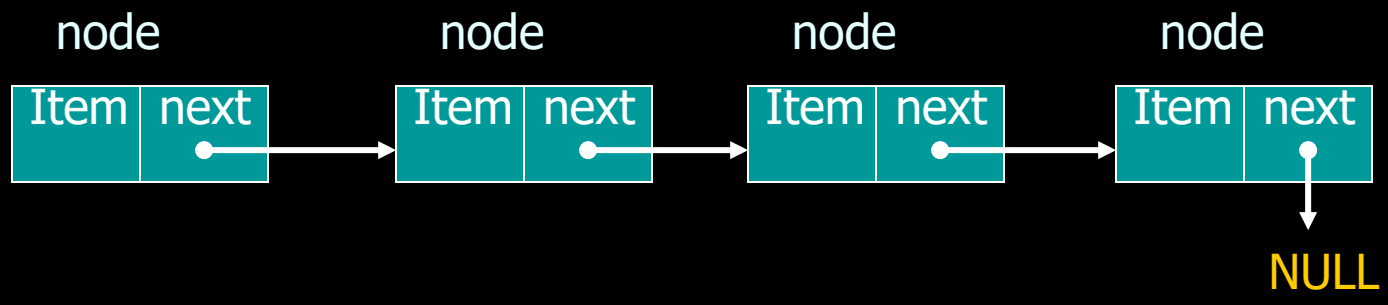
- Create a structure called a *Node*.



- The *object* field will hold the actual list element.
- The *next* field in the structure will hold the starting location of the next node.
- Chain the nodes together to form a *linked* list.

- A very common source of problems in program maintenance is the need to increase the capacity of a program to handle larger collections.

- In a linked list, each item is allocated space as it is added to the list. A link is kept with each item to the next item in the list.



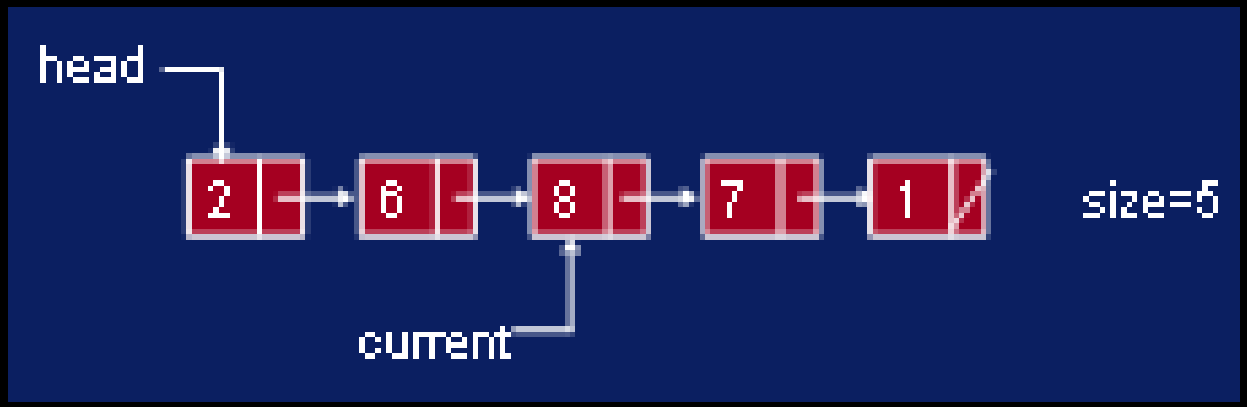
- Each node of the list has two elements:
  - The item being stored in the list and
  - A pointer to the next item in the list
- The last node in the list contains a NULL pointer to indicate that it is the end or tail of the list.

- As items are added to a list, memory for a node is dynamically allocated. Thus the number of items that may be added to a list is limited only by the amount of memory available.

- Handle of the LL : The variable (or handle) which represents the list, is simply a pointer to the node at the head of the list.

Linked List

- Picture of our list (2, 6, 7, 8, 1) stored as a linked list:



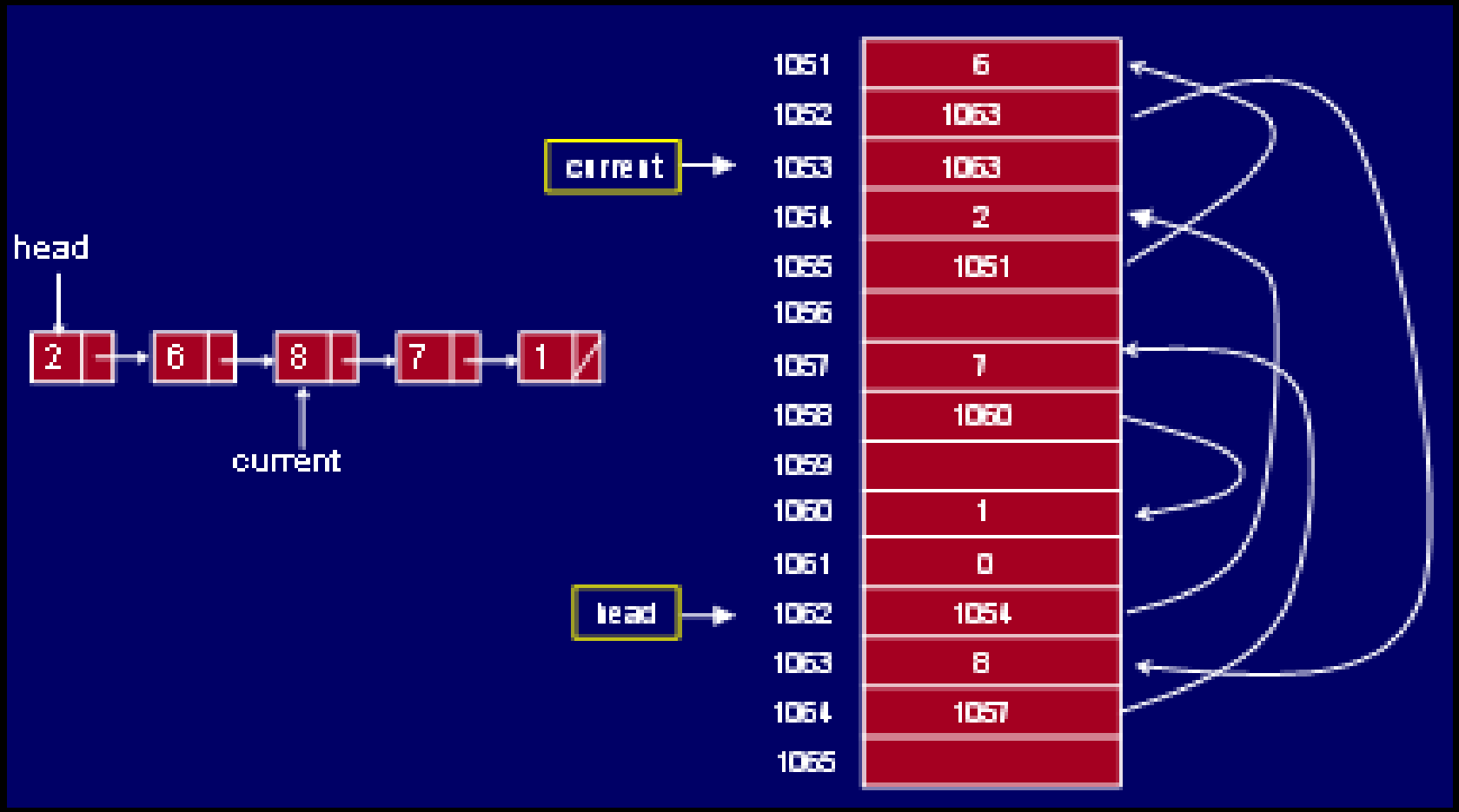
```
class node
   {
      char name[15];
      node *next;
   };
```

Linked List

Note some features of the list:

- Need a *head* to point to the first node of the list. Otherwise we won't know where the start of the list is.
- The *current* here is a pointer, not an index.
- The next field in the last node points to *nothing*. We will place the memory address NULL which is guaranteed to be inaccessible.

Linked List
Actual picture in memory:



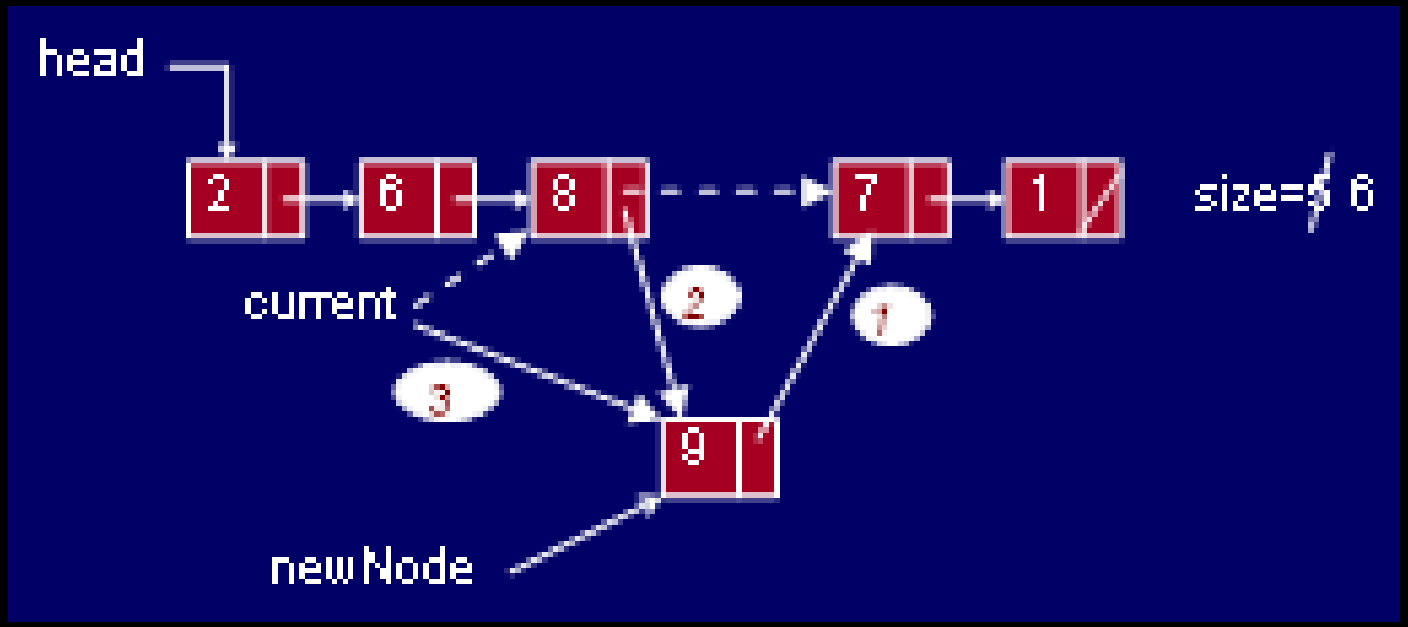
Operations of Link List

- Adding (Inserting) to a Link List (LL) : The simplest strategy for adding an item to a list is to:

1. Allocate space for a new node.
2. Copy the item value into it.
3. Make the new node's next pointer point to the current head of the list and
4. Make the head of the list point to the newly allocated node.

This strategy is fast and efficient but each item is added to the head of the list.

Adding element into link list



- Searching a Link List :

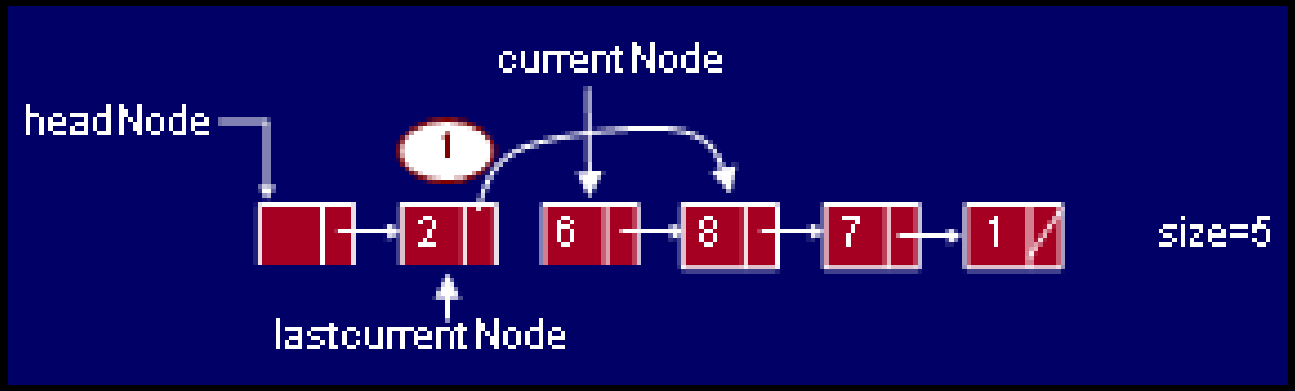
  - To search a list of n objects or elements the search function takes n operations to search a data item in the LL in worst case, since it may have to search the entire link list.

- Deletion from Link List :

  - This removes a data item's node (block) from the start of link list. Pointer must be pointing to that node which has to be deleted and then pointer will have to be updated.

  - But if we wish to delete the particular node (block) with given key to match, then we have to search for that node (block) in the entire Link List.

removing element from link list



Implementation of Link List

- Discussion on *White Board* from *C++* point of view
  - Searching
  - Addition
  - Deletion etc ....

Assignment # 2

- Implement a Linked List (LL) discussed above including following operations.
  - Insertion of node at any place in LL.
  - Deletion of node at any place in LL
  - Searching for a node at any place in LL
  - Printing whole Linked List (LL)
  - Checking emptiness of the LL