# Self-Referential Structures

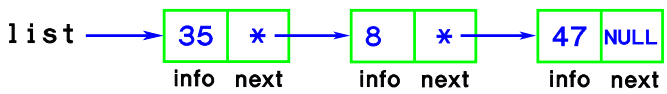
```
struct nodetype
  {
   int info;
   nodetype *next;
  };

nodetype *list;

nodetype *p, *q; //Used later
```



# Linked Lists




*Array representation of same list:*

| | |
|---|---|
| 0 | 35 |
| 1 | 8 |
| 2 | 47 |

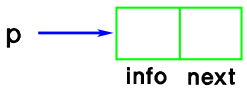
# Linked List Declarations

*To initialize the list:*

```
list = NULL;
```

*Creating a node for the list:*

```
p = new nodetype;
```






# Linked List Operations

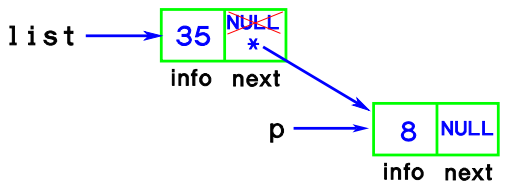
*To add the first node to the list:*

```
p->info = 35; // Value in node
p->next = NULL;
list = p;
```

# Linked List Operations

*To add the second node to the list:*

```
p = new nodetype;
p->info = 8; // Value in node
p->next = NULL;
list->next = p;
```



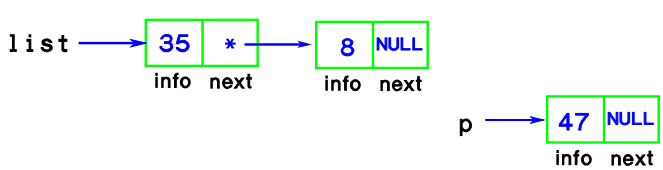



# Linked List Operations

*To add a node to the end of an existing list:*

```
p = new nodetype;
p->info = 47; // Value in node
p->next = NULL;
q = list;
while(q->next != NULL)
   q = q->next;
q->next = p;
```

*List traversal*



# Linked List Operations

*To add a node to the end of any list (even empty):*

```
p = new nodetype;
p->info = 47; // Value in node
p->next = NULL;
if(list == NULL)
   list = p;
else  // traverse the list
  {
   q = list;
   while(q->next != NULL)
      q = q->next;
   q->next = p;
  }
```



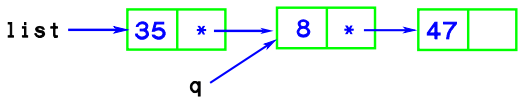
# Linked List Operations

*To add a node to the beginning of a list:*

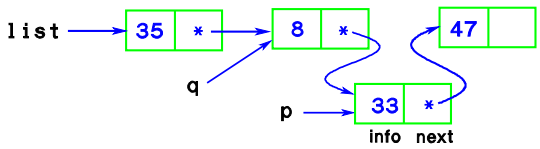
```
p = new nodetype;
p->info = 47; // Value in node
p->next = NULL;
if(list == NULL)
   list = p;
else
  {
   p->next = list;
   list = p;
  }
```

# Linked List Operations

*To add the node pointed to by p to the list after the node pointed to by q:*




```
p = new nodetype;
p->info = 33;
p->next = q->next;
q->next = p;
```

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# Linked List Operations

*To output the list (also a good example of a list traversal):*

```
q = list;
while(q != NULL)
  {
   cout << q->info << endl;
   q = q->next;
  }
```

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## Using a for Statement for List Operations

while version

```
q = list;
while(q != NULL)
  {
   cout << q->info;
   q = q->next;
  }
```

for version

```
for(q = list; q != NULL; q = q->next)
  {
   cout << q->info;
  }
```

*for statements are usually used only for "counting" loops. Here, the for loop conveniently contains all the necessary code to control the list traversal*

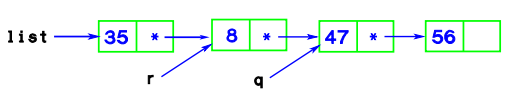




## Linked List Operations – Trailing Pointer

*Since insertion operations require that the position of insertion be indicated by a pointer to the node BEFORE the insertion, a "trailing pointer" can be used. One pointer is used to find the insertion position, and another (trailing) one is used to perform the insertion:*

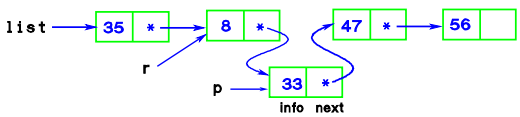
```
q = list; r = NULL;
while(q != NULL)
  {
   // Code to find the correct position goes here
   r = q; q = q -> next;
  }
```



## Linked List Operations – Trailing Pointer

*To do the insertion, use the trailing pointer (r):*

```
if (r == NULL) // insert at beginning of list
  {
   p -> next = list;  list = p;
  }
   else
  {
   p -> next = r -> next;  r -> next = p;
  }
```



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## Trailing Pointer Example

*Insert a node into a list arranged in numeric order:*

```
q = list; r = NULL;
while(q != NULL)
  {
   if(p -> info > q -> info)
      break;
   else
     {
      r = q; q = q -> next;
     }
  } // end while
if (r == NULL)
  {
   p -> next = list;  list = p;
  }
else
  {
   p -> next = r -> next; r -> next = p;
  } // end if
```



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# To Delete a List

```
q = list;
while(q != NULL)
  {
   p = q;
   q = q -> next;
   delete p;
  }
```