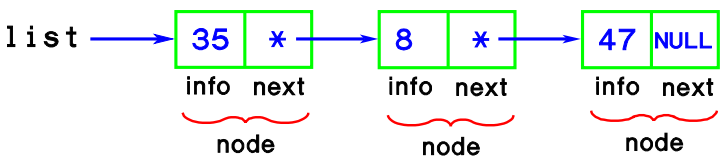
Self-Referential Structures

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

nodetype *list;

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


Linked Lists



Array representation of same list:

0	35
1	8
2	47

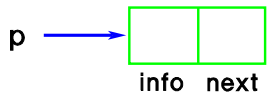
Linked List Declarations

To initialize the list:

```
list = NULL;
```

Creating a node for the list:

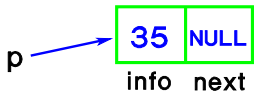
```
p = new nodetype;
```



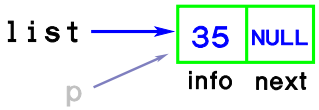
Linked List Operations

To add the first node to the list:

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



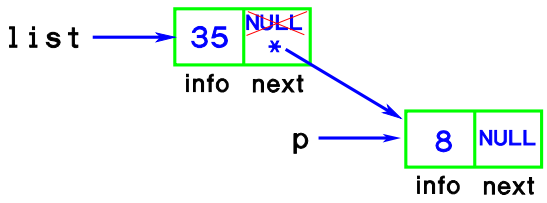

```
list = p;
```



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;
```



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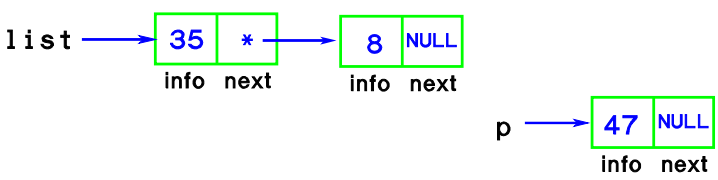
Linked List Operations

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



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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;    // adds first node to list
else            // add second, third, etc.
  {
   q = list;
   while(q->next != NULL) // list traversal
      q = q->next;
   q->next = p;    // link to end of list
  }
```

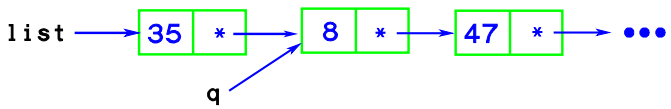

Linked List Operations

To add a node to the beginning of a list:

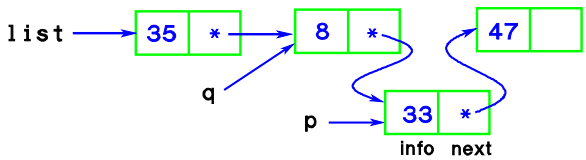
```
p = new nodetype;
p->info = 47; // Value in node
p->next = NULL;
if(list == NULL)
   list = p;
else
  {
   p->next = list;
   list = p;
  }
```

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

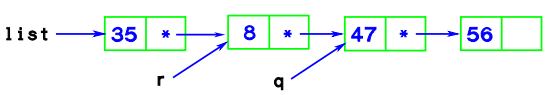
```
for(q = list; q != NULL; q = q->next)
  {
   cout << q->info;
  }
```

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:

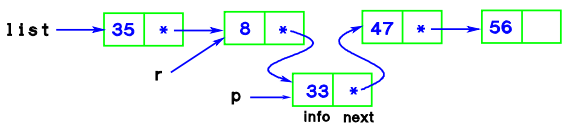
```
q = list; r = NULL;
while(q != NULL)
  {
   // Code to find the correct position goes here
   r = q; q = q -> next;
  }
```



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        // insert in middle of list
  {
   p -> next = r -> next;  r -> next = p;
  }
```



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
```

To Delete a List

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