Operations on Linked Lists

When Needed

- Dynamic allocation is specially appropriate for building lists, trees and graphs.
- We used an array for storing a collection of data items.
- Suppose the collection itself grows and shrinks then using a linked list is appropriate.
- It allows both **insertion**, **deletion**, **search**.
- But the random access capabilities of array is lost.

Operations on Linked Lists

Declaring a Node Type

- Linked list is a collection of data item, where each item is stored in a structure (**node**).
- The structure for node can be declared as follows:

```
struct node {
    int info;
    struct node *next; //ptr to struct of identical type
}
```

Operations on Linked Lists

Head of a List

- Linked list is accessed by accessing its first node.
- Subsequent nodes can be accessed by using the pointer `next`
- So after declaring, a (empty) list is initialized to `NULL`.
- Creating a list is done by creating nodes one after another.

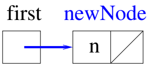
Operations on Linked Lists

Creating Nodes

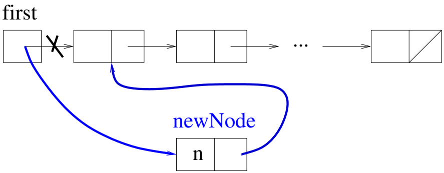
```
struct node *newNode;

// Allocate space for new node.
newNode = malloc(sizeof(struct node));

// Set information to be stored.
(*newNode).info = 0;

newNode->info = 0; // alternative way of referencing fields.
```

Operations on Linked Lists

Inserting a Node at Beginning



insert into an empty list



inserting into a nonempty list

Operations on Linked Lists

Inserting a Node at Beginning

There are two limiting cases that should be handled properly:

- List could be an empty list.
- The element to be inserted may already be present.

```
#include <stdio.h>
#include <stdlib.h>
struct node {
    int info;
    struct node *next;
};
```

Operations on Linked Lists

Inserting a Node at Beginning

```
struct node *searchList(struct node *list, int n) {
   struct node *p = list;
   while (p != NULL) {
      if (p->info == n)
         break;   // Search successful
      else
         p = p->next; // Check next node
   }
   return p;
}
```

Operations on Linked Lists

Inserting a Node at Beginning

```
struct node *addToList(struct node *list, int n) {
   struct node *newNode;

   if (searchList(list, n) != NULL) {
       printf("%d exists, add not allowed \n", n);
       return list;
   }
   else {
       newNode = malloc(sizeof(struct node));
       if (newNode == NULL)
           printf("Creation of node failed\n");
       else {
           newNode->info = n;
           newNode->next = list;
        }
   }
   return newNode; // Becomes the first node of the list.
}
```

Operations on Linked Lists

Inserting a Node at Beginning

```
void printList(struct node *list) { // Print the list
    struct node *p = list;
    while (p != NULL) {
        printf("%5d", p->info);
        p = p->next;
    }
    printf("\n");
}
int main() {
    int i;
    struct node *first = NULL;
    for (i = 0; i < 5; i++)
        first = addToList(first, (i+1)*10);
    printList(first);
}
```

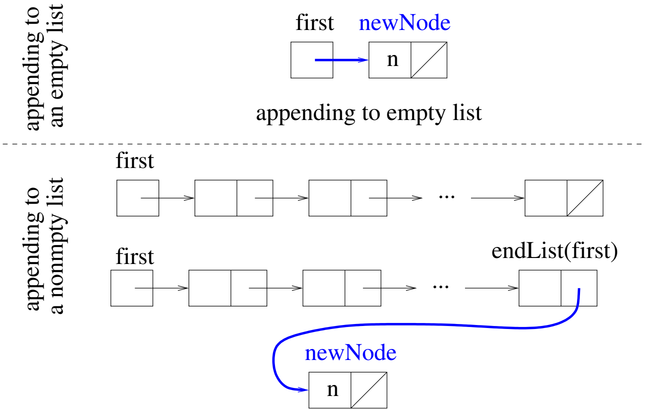
Operations on Linked Lists

Append to a Linkded List

- Navigate the linked list to reach the last node:
  - Create a `newNode`, set its `info` field to value provided.
  - Set `next` of `newNode` to `NULL`.
  - Set the `next` field of the last node in the linked list to point to `newNode`.
- Handle the case of empty linked list (return pointer to `newNode`)

Operations on Linked Lists

Append to a Linked List



Operations on Linked Lists

Find the Tail of a Linked List

```
struct node *endList(struct node *list) {
   struct node *p = list;

   if (p == NULL)
       return NULL; // Empty linked list
   while (p->next != NULL)
       p = p->next;
   return p;  // Last node of the linked list
}
```

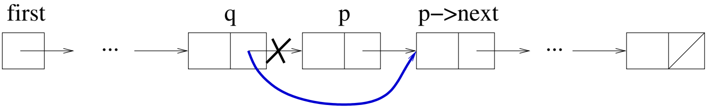
Operations on Linked Lists

Append to a Linked List

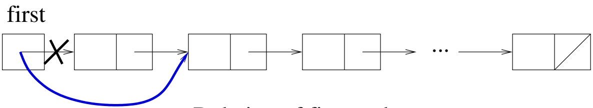
```
struct node *appendToList(struct node *list, int n) {
    struct node *newNode, *p;
    if (searchList(list, n)    != NULL)
        printf("%d exists in the list, append not allowed\n", n);
    else {
        newNode = malloc(sizeof(struct node));
        newNode->info = n;
        newNode->next = NULL;
        p = endList(list);
        if (p != NULL)
            p->next = newNode;
        else
            list = newNode;
    }
    return list;
}
```

Operations on Linked Lists

Delete from a Linked List



Deletion a middle node



Deletion of first node