Dynamic memory management

- To allocate memory on the heap use the ‘new’ operator
- To free the memory use delete

```
int *p= new int;
delete p;
```

Dangling pointers and memory leaks

- Dangling pointer: Pointer points to a memory location that no longer exists
- Memory leaks (tardy free):
  - Heap memory not deallocated before the end of program
  - Heap memory that can no longer be accessed

Dynamic memory pitfalls

- Does calling foo() result in a memory leak? [✓ A. Yes] B. No

```
void foo(){
    int * p = new int;

}
```

Q: Which of the following functions returns a dangling pointer?

```
int* f1(int num){
    int *mem1 =new int[num];
    return(mem1);
}
```

```
int* f2(int num){
     int mem2[num];
     return(mem2);
}
```

A. f1

[✓ B. f2]

C. Both

Homework 7, problem 4

```
void printRecords(UndergradStudents records [], int numRecords);
int main(){
    UndergradStudents ug[3];
    ug[0] = {"Joe", "Shmoe", "EE", {3.8, 3.3, 3.4, 3.9} };
    ug[1] = {"Macy", "Chen", "CS", {3.9, 3.9, 4.0, 4.0} };
    ug[2] = {"Peter", "Patrick", "ME", {3.8, 3.0, 2.4, 1.9} };
    printRecords(ug, 3);
}
```

Expected output

```
These are the student records:
ID# 1, Shmoe, Joe, Major: EE, Average GPA: 3.60
ID# 2, Chen, Macy, Major: CS, Average GPA: 3.95
ID# 3, Peter, Patrick, Major: ME, Average GPA: 2.77
```

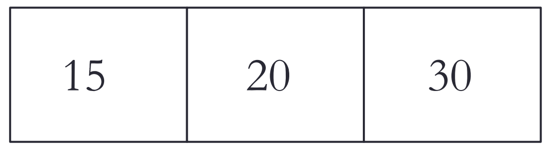
DYNAMIC MEMORY ALLOCATION LINKED LISTS

Problem Solving with Computers-I

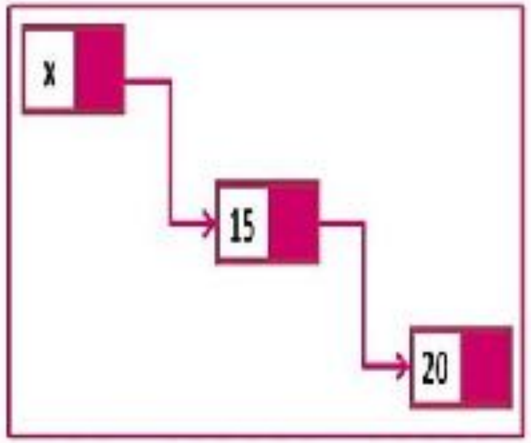
```
#include <iostream>
using namespace std;

int main(){
    cout<<"Hola Facebook!";
    return 0;
}
```

GitHub

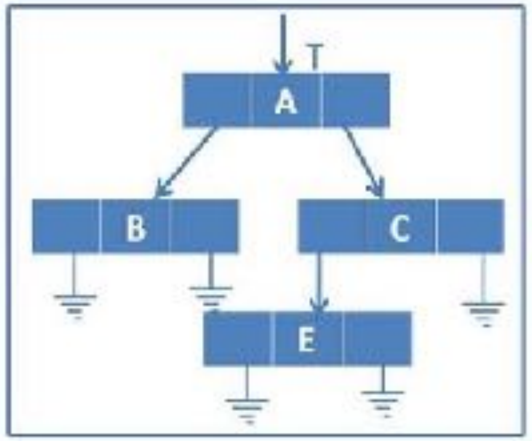
Different ways of organizing data!



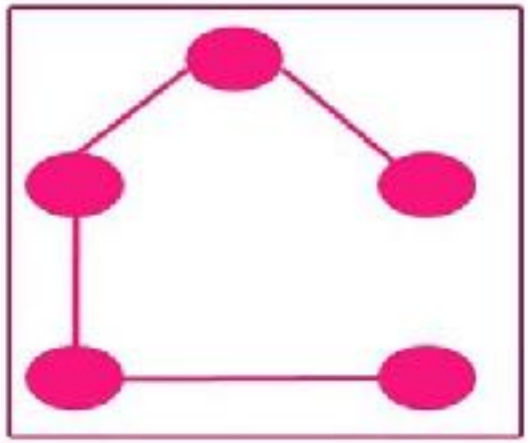
Array List



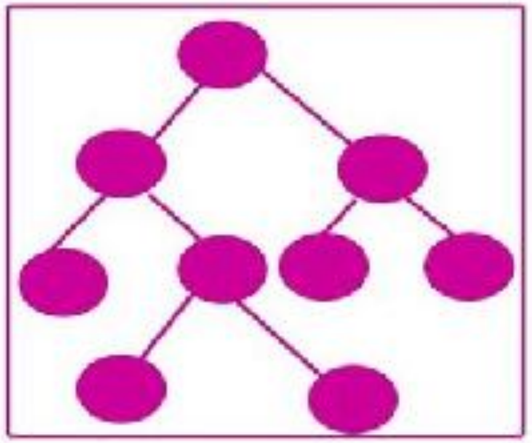
Link list



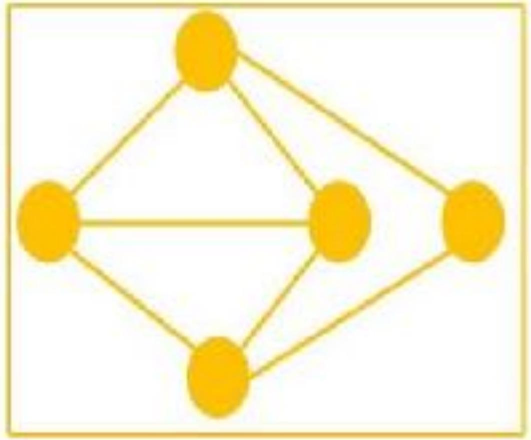
list



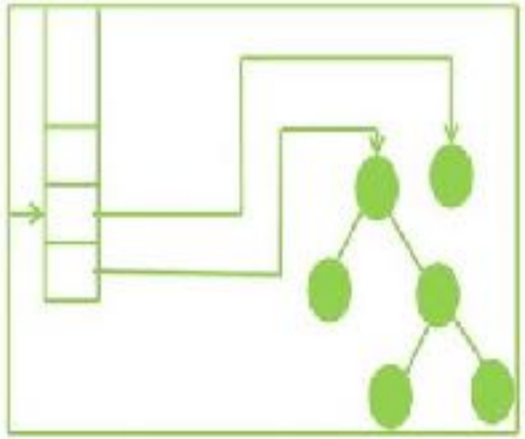
spanning tree



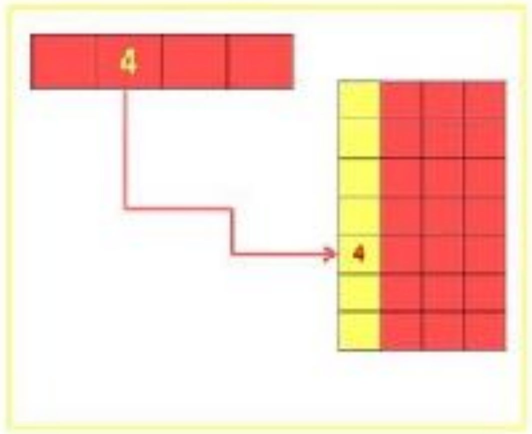
Tree



Graph

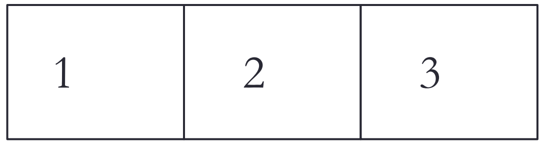


Stack



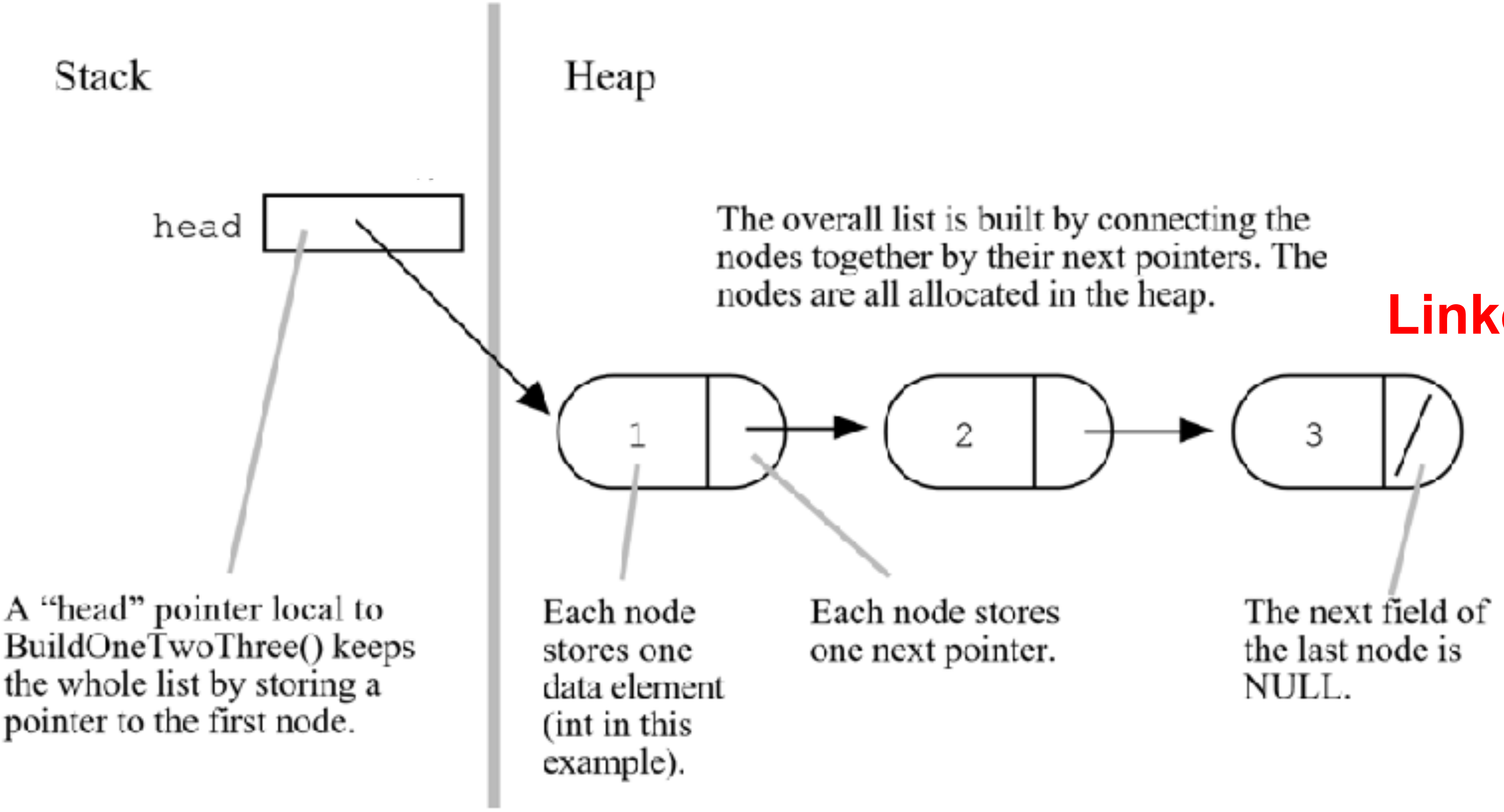
Hashing

Linked Lists



Array List

The Drawing Of List {1, 2, 3}



The overall list is built by connecting the nodes together by their next pointers. The nodes are all allocated in the heap.

Linked List

A "head" pointer local to BuildOneTwoThree() keeps the whole list by storing a pointer to the first node.

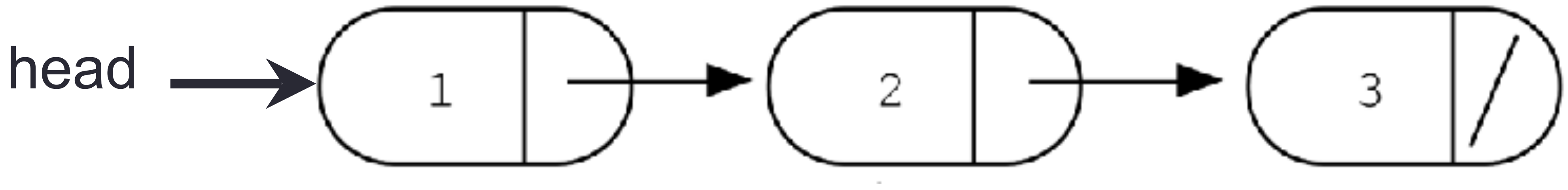
Each node stores one data element (int in this example).

Each node stores one next pointer.

The next field of the last node is NULL.

Accessing elements of a list

```
struct Node {
        int data;
        Node *next;
};
```



Assume the linked list has already been created, what do the following expressions evaluate to?

1. head->data A
2. head->next->data B
3. head->next->next->data C
4. head->next->next->next->data E

A. 1
B. 2
C. 3
D. NULL
E. Run time error

Creating a small list

- Define an empty list
- Add a node to the list with data = 10

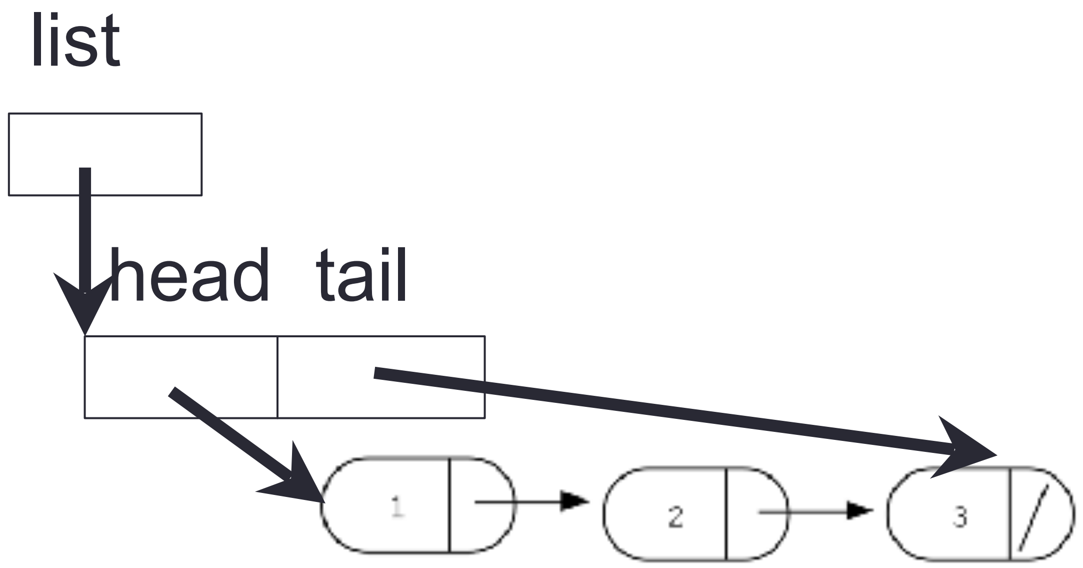
```
struct Node {
        int data;
        Node *next;
};
```

Inserting a node in a linked list

```
Void insertToHeadOfList(LinkedList* h, int value) ;
```

Iterating through the list

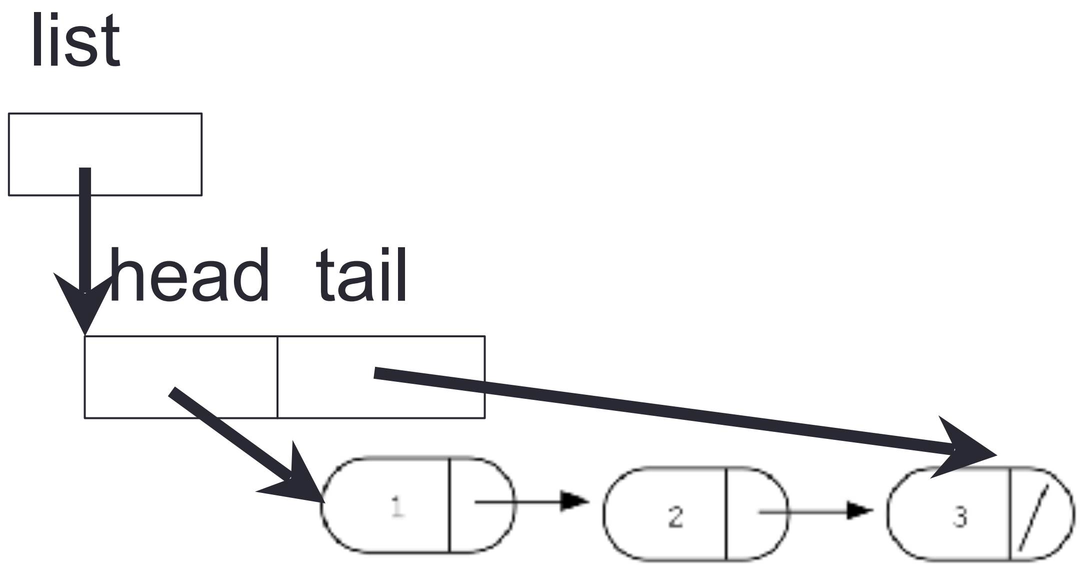
```
int lengthOfList(LinkedList * list) {
   /* Find the number of elements in the list */
```



```
}
```

Deleting the list

```
int freeLinkedList(LinkedList * list) {
   /* Free all the memory that was created on the heap*/








}
```


list
head
tail
1
2
3