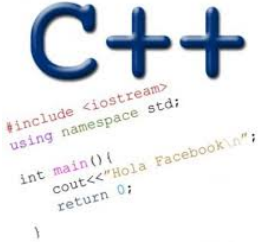
LINKED LISTS AND THE RULE OF THREE

Problem Solving with Computers-II

Have you implemented a Linked List before

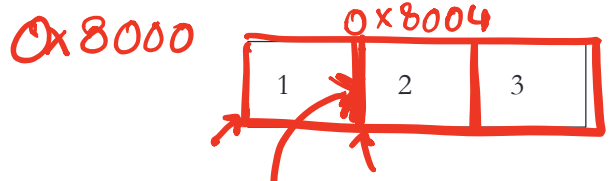
A. Yes

B. NO

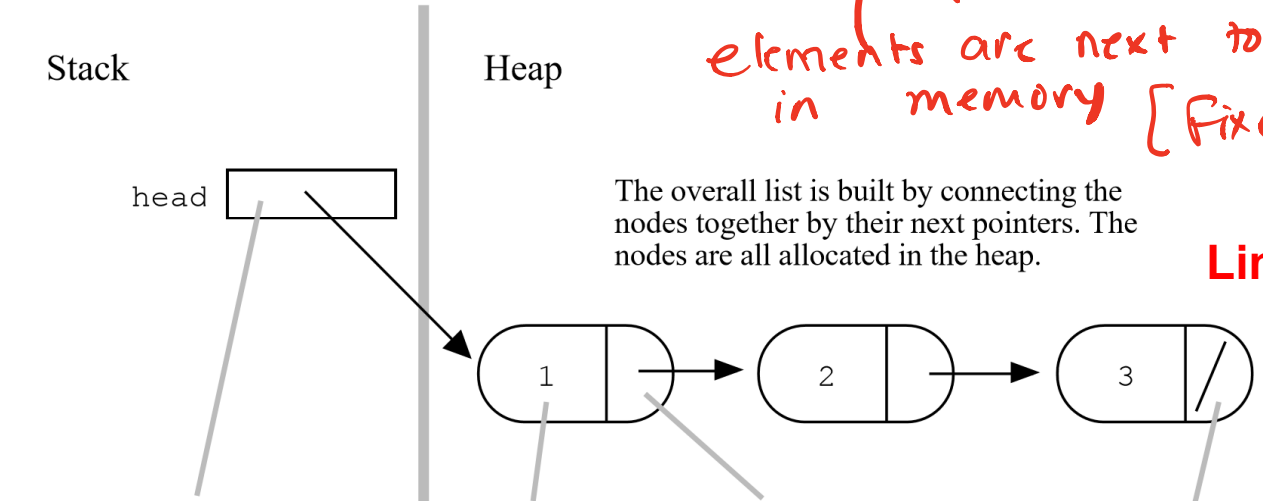


Linked Lists

The Drawing Of List {1, 2, 3}



Array List

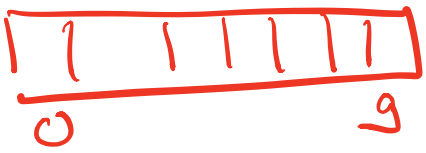


Linked List

What is the key difference between these?

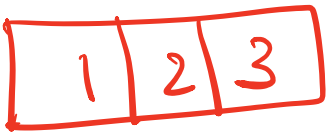
```
int arr [ 10 ] ;
```

No. of ELEMENTS




```
int arr [] = {1, 2, 3};
```

Single Linked List



arr

(Pointer)

data next

next

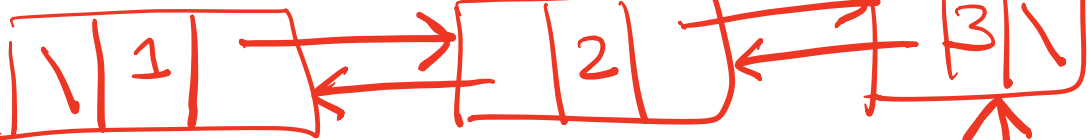
Need to explicitly store the location of the next node

head

Double linked list

prev data next

prev next



head

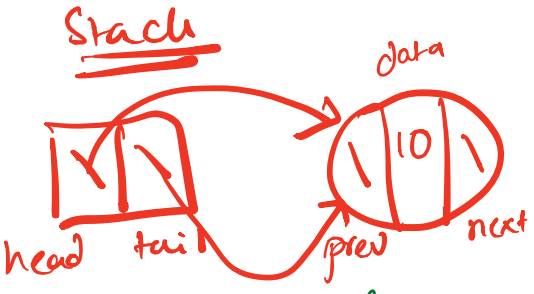
tail

```
Class LinkedList {

// Member Functions

private:
 // Member Variables (Data)
 //
};
```

→ LinkedList list;



list.append(10);

In class we discussed why we should create this node on the heap instead of the stack

Questions of interest about any data structure:

- **What operations does the data structure support?**
  A linked list supports the following operations:
  1. Insert (a value)
  2. Delete (a value)
  3. Search (for a value)
  4. Min
  5. Max
  6. Print all values
- **How do you implement each operation?**
- **How fast is each operation?**

Linked-list as an Abstract Data Type (ADT)

```
class LinkedList {
public:
    LinkedList();                   // constructor
    ~LinkedList();                  // destructor
    // other methods
private:
    // definition of Node
    struct Node {
        int info;
        Node *next;
    };
    Node* head; // pointer to first node
    Node* tail;
};
```

RULE OF THREE

If a class defines one (or more) of the following it should probably explicitly define all three:

1. Destructor
2. Copy constructor
3. Copy assignment

The questions we ask are:

1. What is the behavior of these defaults?
2. What is the desired behavior ?
3. How should we over-ride these methods?

Behavior of default destructor

```
void test_append_0(){
     vector<int> v_exp = {1};
     LinkedList ll;
     ll.append(1);
     vector<int> v_act = ll.vectorize();
     TESTEQ(v_exp, v_act, “test 0");
}
```

Assume:

destructor: default

copy constructor: default

copy assignment: default

What is the output?

A. Compiler error

B. Memory leak

C. Segmentation fault

D. Test fails

E. None of the above

The destructor code for LinkedList does which of the following?

A. Frees the LinkedList object from the heap
B. Frees the Nodes in a LinkedList from the heap
C. Both A and B
D. None of the above

Behavior of default copy constructor

```
void test_copy_constructor(){
   LinkedList l1;
   l1.append(1);
   l1.append(2);
   LinkedList l2(l1);
   TESTEQ(l1, l2, "test copy constructor”);
}
```

Assume:
destructor: overloaded
copy constructor: default
copy assignment: default

What is the output?
A. Compiler error
B. Memory leak
C. Segmentation fault
D. Test fails
E. None of the above

Behavior of default copy assignment

```
void test_copy_assignment(){
   LinkedList l1;
   l1.append(1);
   l1.append(2);
   LinkedList l2;
   l2 = l1;
   TESTEQ(l1, l2, "test copy assignment”);
}
```

Assume:
destructor: overloaded
copy constructor: overloaded
copy assignment: default

What is the output?
A. Compiler error
B. Memory leak
C. Segmentation fault
D. Test fails
E. None of the above

Write another test case for the copy assignment

```
void test_copy_assignment_2(){
// Write another test case for the copy assignment operator



}
```

See code from lecture 5

Behavior of default copy assignment

Assume that your implementation of LinkedList uses the overloaded destructor, default: copy constructor, copy assignment

l1 : 1 -> 2- > 5 -> null

```
void test_default_assignment_2(LinkedList& l1){
   // Use the copy assignment
   LinkedList l2;
   l2.append(10);
   l2.append(20);
   l2 = l1;
}
* What is the default behavior?
```

Next time

- Linked Lists counted
- Operator overloading
- Unit testing
- GDB