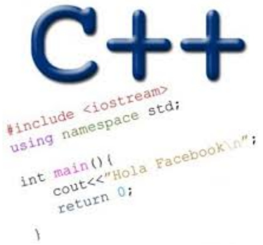
# LINKED LISTS AND THE RULE OF THREE
# UNIT TESTING
# OPERATOR OVERLOADING

Problem Solving with Computers-II

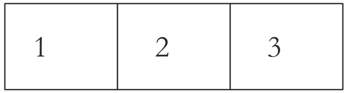


```
#include <iostream>
using namespace std;

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

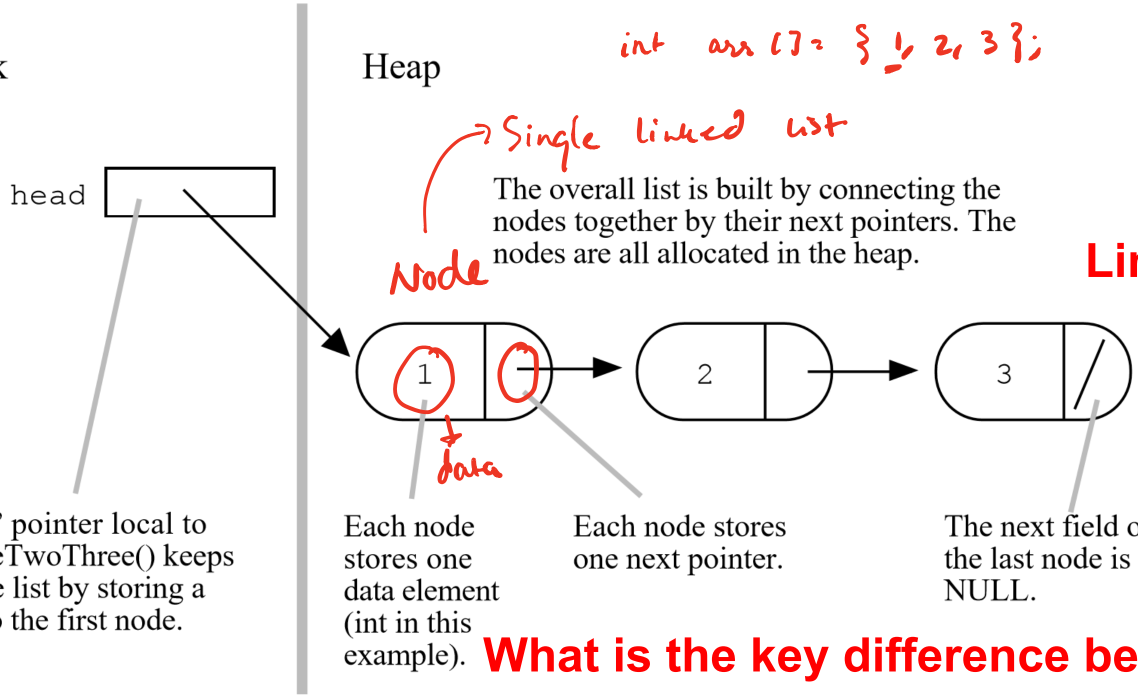
# Linked Lists

**The Drawing Of List {1, 2, 3}**



**Array List**

int arr [] = { 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.

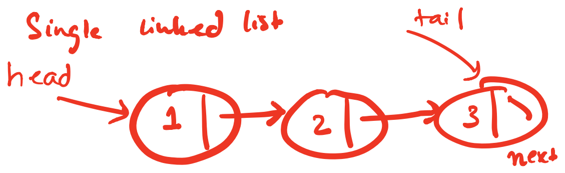
Each node stores one data element (int in this example).

Each node stores one next pointer.

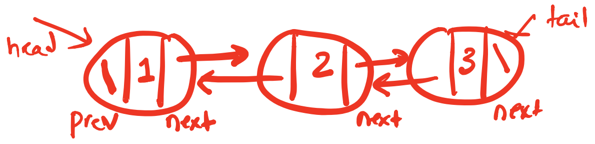
The next field of the last node is NULL.

**What is the key difference between these?**

Single linked list



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



Double - linked list

```
struct Node {

        int data;
        Node * prev;
        Node * next;

};
```

# Questions you must ask 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

$\left.\right\}$ public methods of class linked_list

- **How do you implement each operation?**
- **How fast is each operation?**

(future lectures)

Use the approach of Test Driven Development (TDD) to implement each function

# 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;      } → Nodes in a single linked List
        Node *next;    }
    };
    Node* head; // pointer to first node
    Node* tail; // pointer to the last node
};
```

## Unit testing

- The goal of unit tests is to design your software robustly (usually viaTest Driven Development)
- For our purposes each public method of a class is a unit under test (UUT)
- Organizing your unit tests
  - One test class for every class under test.
  - If the class to test is Foo, the test class should be called FooTest (not TestFoo)
  - One test function for every public function of Foo. This a suite of individual test cases
- Test cases should be independent
- Test cases should be orthogonal
- For additional guidelines see: https://petroware.no/unittesting.html

Please review code written in lecture (check github)

## Overloading Binary Comparison Operators

We would like to be able to compare two objects of the class using the following operators

==

!=

and possibly others

} we'll discuss overloading other operators in the next class

```
void isEqual(const LinkedList & lst1, const LinkedList &lst2){
     if(lst1 == lst2)
            cout<<"Lists are equal"<<endl;
     else
           cout<<"Lists are not equal"<<endl;

}
```

## RULE OF THREE

(Next class → need this for lab02)

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?

## Assume default destructor, copy constructor, copy assignment AND Correct implementation of the methods append() and vectorize()

```
void test_append_0(){
      string testname = "test 0: append [1] “;
      vector<int> v_exp = {1};
      LinkedList ll;
      ll.append(1);
      vector<int> v_act = ll.vectorize();
      if(v_act!=v_exp){
            cout <<"\tFAILED "<<testname<<endl;
      }else{
            cout <<"\tPASSED "<<testname<<endl;

      }
}
```

What is the expected behavior of this code?

A. Compiler error

B. Memory leak

C. Code is correct and the test passes

D. None of the above

## Behavior of default copy constructor

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

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

```
void default_copy_constructor(LinkedList& l1){
    // Use the copy constructor to create a
    // copy of l1









}
* What is the default behavior?
* Is the default behavior the outcome we desire ?
* How do we change it?
```

## Behavior of default copy assignment

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

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

```
void default_assignment_1(LinkedList& l1){
   LinkedList l2;
   l2 = l1;
}
* What is the default behavior?
```

## 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 contd.
- GDB