LINKED LISTS AND THE RULE OF THREE
UNIT TESTING
OPERATOR OVERLOADING

Problem Solving with Computers-II

Linked Lists

Array

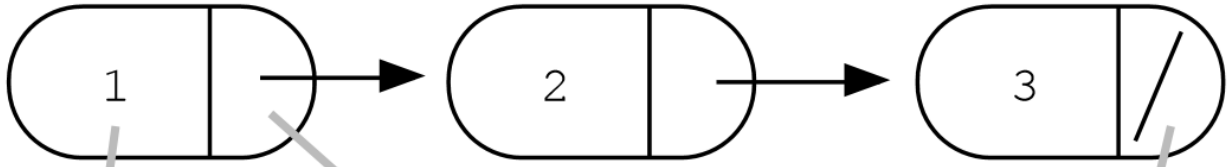
The Drawing Of List {1, 2, 3}

Stack

Heap

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?

Linked Lists

The Drawing Of List {1, 2, 3}

delete head; <— this line deletes which of the following?

Stack

Heap

head

(A)

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

1

2

3

(B)

(C)

(D)

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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
- **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;
};
```

Unit testing

- The goal of unit tests is to design your software robustly (usually via Test 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

Overloading Binary Comparison Operators

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

==

!=

and possibly others

```
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

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 override these methods?

Assume default destructor, copy constructor, copy assignment AND Correct implementation of the methods append(), vectorize(), operator!=

```
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 overridden 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