Recitation 11: Linked List Basics

Topic

- linked lists

Recitation Instructions

There are three tasks given for this recitation. The first two are required. The third need only be done if you have time *during* lab.

It might be good if you ask a lab worker to check off the first task before proceeding to the second, but is not required.

Do, however, have the task two checked before moving on to task three.

For simplicity, please put all tasks in a single program. Make sure that the output clearly identifies what is being tested.

Recitation Project(s)

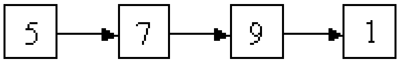
Task One

Create and test the function(s) needed for this problem.

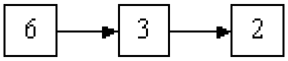
Splice a singly linked list of `ints` into another list of `ints` given a pointer to the node that you will insert after.

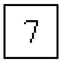
E.g.:

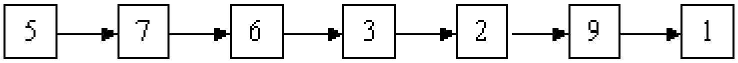
If the original list was

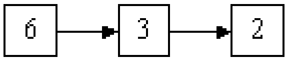
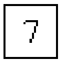


and the list to splice in was



and if the function is passed a pointer to node containing the  in the original list,
the resultant list would be



Note that the  list was spliced into the original list after the node containing the .

Requirements:

- you must use this attached provided code to work from
- Do **not** create any new Nodes.
- Do **not** define any additional types. You only need the Node struct. In particular you should *not* define a "List" class.
- the splice-into function must be void

Assumptions:

- the function will not attempt to splice before the first node in the original list

Considerations:

- Do not use any other code from the course's sample code
- can we use the code that splices a list between two nodes to splice a list after the last node?

Testing:

- print both lists before the splice and print the original list after splicing.

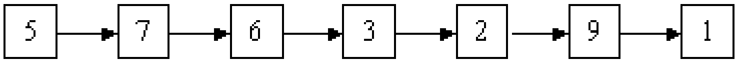
Task Two

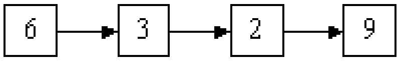
Create and test the function(s) needed for this problem.

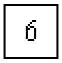
Given two lists of `ints`, is the second list a sublist of the first?

E.g.:

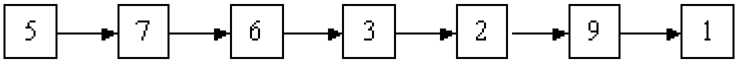
<u>Situation: Second list is a sublist of the first</u>.

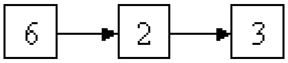
If the list to be searched is 

and the list to be looked for is 

the function should return a pointer to the node  in the list to be searched.

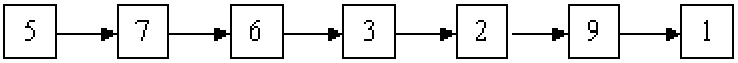
<u>Situation: Second list is not a sublist of the first</u>.

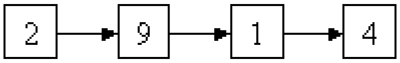
If the list to be searched is 

and the list to be looked for is 

the function should return `nullptr`.

<u>Situation: Second list is not a sublist of the first</u>.

If the list to be searched is 

and the list to be looked for is  the function should return `nullptr`.

Requirements:

- the isSubList function must return a pointer to the node where the sublist starts in the searched list or `nullptr` if not found

Considerations:

- what if there is more than one match of the sublist

Testing:

- print the lists
- print the list returned by the isSubList function

Sample Output:

```
Part One:

L1: 5 7 9 1
L2: 6 3 2
Target: 7 9 1
Splicing L2 at target in L1
L1: 5 7 6 3 2 9 1
L2: 6 3 2 9 1
=====================

Part two:

Target: 1 2 3 2 3 2 4 5 6

Attempt match: 1
1 2 3 2 3 2 4 5 6

Attempt match: 3 9
Failed to match

Attempt match: 2 3
2 3 2 3 2 4 5 6

Attempt match: 2 4 5 6
2 4 5 6

Attempt match: 2 3 2 4
2 3 2 4 5 6

Attempt match: 5 6 7
Failed to match
```

Task Three

In this task you will write a function that is passed two linked lists. It is *possible* that two list "share" a sublist. By share, we mean that actual nodes from one list appear in the other. Naturally these shared nodes *can only appear* as a *suffix* of the two lists. Your goal is to return a pointer to the first node that the two lists share, or to return a nullptr if there is none. Your test code should print the shared list.

Without the help of an auxiliary data structure, this would be fairly time consuming. I.e. if the two lists are named L1 and L2, and we denote the length of a list L by |L|, then a brute force approach would cost O(|L1| * |L2|). I would like you to first implement a solution of this form.

Of course, we can do much better using some form of *set* data structure. C++ provides two of them, one that keeps the items "in order" and the second that does not. (From your data structures course, you hopefully remember how these are likely to be implemented.)

The class we will use is called `unordered_set`. Like the `vector` class, we will need to include a header file:

```
#include<unordered_set>;
```

Also, as with the `vector` class, the `unordered_set` is defined with the type of thing that it hold. So if we wanted to define an unordered set of ints called "stuff", the definition would look like:

```
unordered_set<int> stuff;
```

`unordered_set` has three methods that you can easily use to solve this problem:

- `insert`: which takes a single value to be added to the set. If the item is already in there, the item will *not* be added.
- `find`: which locates a value in the set. We are only concerned with what it returns if the element is *not* there, which is the next method:
- `end`. This methods takes no arguments. All you need to know for now is that the method `find` will return the same value as `end`, *if* the item passed to `find` is not present in the set.

Given this data structure, and realizing that `find` and `insert` methods will be expected time O(1) operations, then you can solve the problem in O(|L1| + |L2|) time.

For those who might be wondering, yes, we could write this without the `find` method, but you would have to know a little bit more about how data structures like this work in C++, and I don't want to bother you with those details right now. We will cover them shortly.