Lists and Linked Lists

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Opening Discussion

- Let's look at solutions to the interclass problem.
- Do you have any questions about the assignment?

Abstract Data Types (ADTs)

- One of the most powerful concept in computer science is the abstract data type.
- This is something that hold information for us and defines a certain set of operations we can do on that data.
- The ADT does not tell you how it will do those operations. This is critical as most operations can be done in different ways.
- Some common ADTs include the following.
  - List
  - Map
  - Set

Lists

- Today we will concern ourselves with the list ADT. Conceptually this is quite simple. Think of the lists you write yourself to help organize.
- You have certain operations.
  - Get element from list
  - Add element to list
  - Insert into the list
  - Remove from the list
  - Get the size of the list
- There might be others, but those are the basics.
- Once again, the list ADT doesn't tell you how to store the elements or do these things. It just says that a list must do them.

Array Based List

- You could write all of these functions using an array as the storage mechanism for your list.
- Let's think about the different functions we have to implement.
  - Getting an element is just looking up by index
  - Adding an element at the end is storing it and then keeping track of the fact we have one more.
  - Inserting into the list requires moving other elements down to make a hole in the list.
  - Removing from the list requires moving elements down to fill up the hole.
  - Return a stored value for the size.
- Some of these are fast, but others aren't. The slow ones require a lot of memory movement.

Linked Lists

- The solution to this is to use a different implementation of the list: a linked list.
- A linked list is made out of nodes that store data. Each node knows about one or two of it's neighbors.
- If it knows about one it is called a singly linked list. If it knows about two it is a doubly linked list.
- To build a linked list we need a structure for the nodes and most of the time we'll have a structure for the list to hide the nodes in.
- The linked list is efficient for adding and removing, but random access is slow.

Minute Essay

- What do you have to do to return a random element from a linked list?
- Quiz #6 is at the beginning of next class.
- Interclass Problem – Write an implementation for an array based list with the five operations mentioned in this lecture.