Linked Lists

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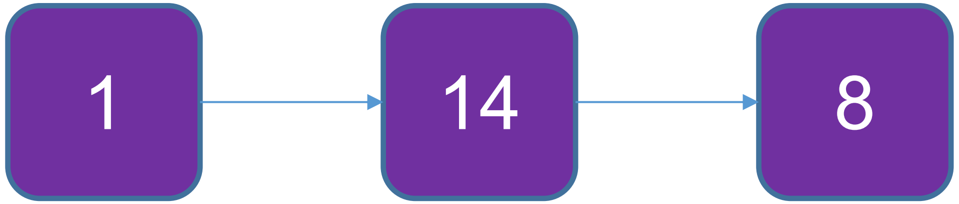
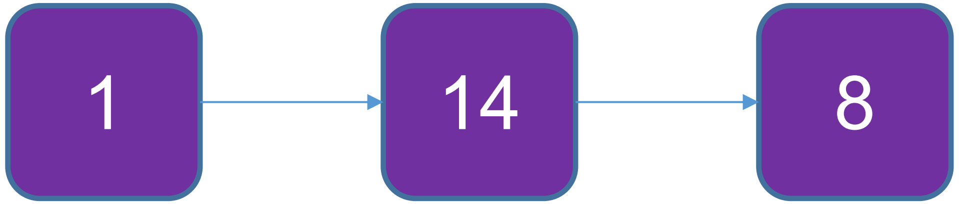
What is a LinkedList?

- A collection of **nodes**, where each node consists of data and next pointer.
- The first node in a linked list is called the *head* node.
- The final node in a linked list, called the *tail*, points to null.



Linked Lists vs Arrays

- Linked Lists are dynamically sized, while the size of an array cannot be changed as easily
- Accessing the **k**th element in an array takes constant time, while it takes **k** time for a linked list
- Both take up O(n) space to store n elements.
- Linked Lists take slightly more space, however, as they need to store pointers to each element



Declaring a Linked List - Python

Declaration

```
class Node:
    def __init__(self, dataval=None):
        self.dataval = dataval
        self.nextval = None
```

Implementation

```
my_linked_list = Node(“first element”)
my_linked_list.next = Node(“second element”)
my_linked_list.next.next = Node(“third element”)
```

Declaring a Linked List - Java

Declaration

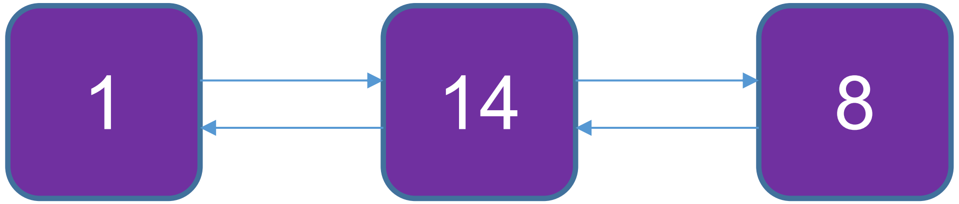
```
class LinkedList {
    Node head; // head of the list
    /* Linked list Node*/
    class Node {
        int data;
        Node next;
        // Constructor to create a new node, leave
      next as null
        Node(int d) { data = d; }
    }
}
```

Implementation

```
/* Start with the empty list. */
LinkedList list = new LinkedList();
 list.head = new Node(1);
```

Types of LinkedLists

- Singly LinkedList
- Doubly LinkedList (has prev and next)
- Circular LinkedList (all nodes are connected to form a circle
- Some LinkedLists have tail node. Useful to append to the list in O(1) time
- Some lists have partial cycles and could result in an endless loop if we are not careful.



Time Complexity Table

	Singly Linked	Doubly Linked
Search		
Insertion to Sorted		
Insertion to Unsorted		
Deletion		

Time Complexity Table

	Singly Linked	Doubly Linked
Search	O(n)	O(n)
Insertion to Sorted	O(n)	O(n)
Insertion to Unsorted	O(1)	O(1)
Deletion	O(n)	O(n)*

*O(1) with reference to node

In class Assignment

Easy: Merge 2 sorted Lists

Easy: Linked List Cycle

Easy: Reverse Linked List

Medium: Add 2 numbers

Medium: Copy List with Random Pointer

Hard: Merge k sorted Lists

Homework

Easy: Remove Duplicates from Sorted List

Medium: Reverse Linked List 2.

Medium: Remove Nth from end of list

Medium: Rotate List

Medium: Swap nodes in pairs

Medium: LinkedList Cycle 2

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