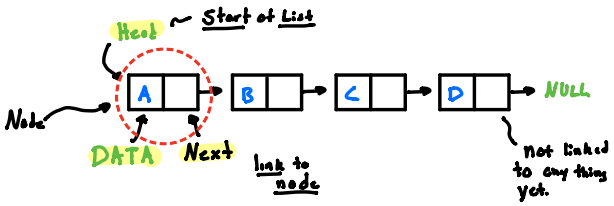
Singly Linked Lists

Insertion



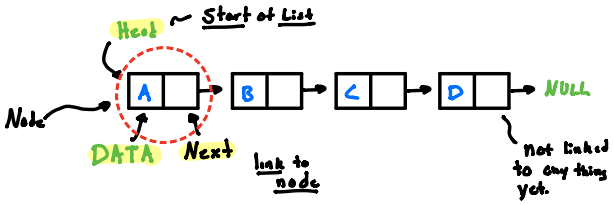
Array vs. Linked List

	Array	Linked List
Insertion/Deletion	O(n)	O(1)
Access Element	O(1)	O(n)
Contiguous Memory?	Yes	No

How to use pointer to traverse until we find the value we are looking for

Move entire array for array

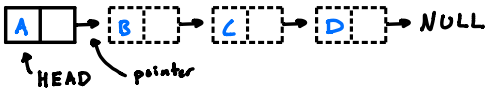
Python Implementation of a Linked List



Insertion

- 3 ways
- Append to end of list
- Prepend to Beginning
- Insert after Node

Append to end of the linked list



Append B, then C, then D

```
class Node:

    def __init__(self, data):
        self.data = data
        self.next = None

class LinkedList:
    def __init__(self):
        self.head = None

    def print_list(self):
        '''Printing the linked list'''
        cur_node = self.head
        # while current node is not null
        while cur_node:

            print(cur_node.data)
            cur_node = cur_node.next

    def append(self, data):
        '''Adding an element to the back of the linked list'''
        new_node = Node(data)

        if self.head is None:
            self.head = new_node
            return

        last_node = self.head
    Ⓐ while last_node.next:
            last_node = last_node.next
        last_node.next = new_node


llist = LinkedList()
llist.append("A")
llist.append("B")
llist.append("C")
llist.append("D")

print("Initial list")
llist.print_list()
```

```
Initial list
A
B
C
D
```

Node Class

initializing the head of the list

prints our linked list

Turns our element into a node

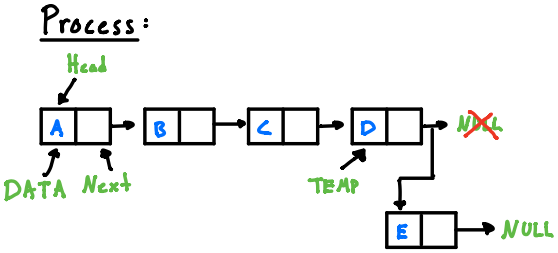
if there isn't a head yet then our element becomes one.

Keeps track of our head node, were at the start of the list (called last_node, because that's what it will eventually point to)

- We want to move through the list
  - Until it's pointing to NULL, then that's where we will input our new node.

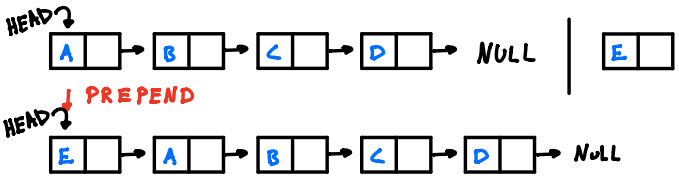
Append node to end of the list

Process:



Ⓐ
- While the next pointer is not NULL, we will continue in this loop
- What were doing in this loop is moving the head pointer to the right
- After the loop has concluded, the last node will point to the last node

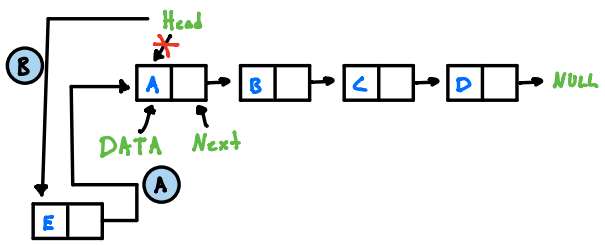
Add element to the beginning of the Linked List (Prepend)



- Create new node
- Set new node should point to A
- Move head from A to E

```
class Node:
    def __init__(self, data):
        self.data = data
        self.next = None


class LinkedList:
    def __init__(self):
        self.head = None

    def print_list(self):
        cur_node = self.head
        while cur_node:
            print(cur_node.data)
            cur_node = cur_node.next

    def append(self, data):
        new_node = Node(data)

        if self.head is None:
            self.head = new_node
            return

        last_node = self.head
        while last_node.next:
            last_node = last_node.next
        last_node.next = new_node
```

Process:




```
    def prepend(self, data):
        new_node = Node(data)

        new_node.next = self.head
        self.head = new_node
```

Create new node

A - Set new node should point to the head of the list

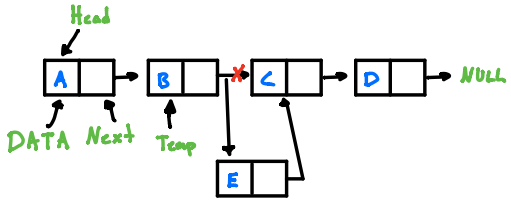
B Set head to the new node that we just prepend

```
llist = LinkedList()
llist.append("A")
llist.append("B")
llist.append("C")
llist.append("D")

llist.prepend("E")

llist.print_list()
```

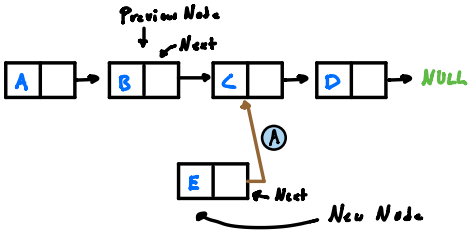
```
E
A
B
C
D
```

← Prepended to the beginning of the linked list.

Insert and element after a Node




```
class Node:
    def __init__(self, data):
        self.data = data
        self.next = None


class LinkedList:
    def __init__(self):
        self.head = None

    def print_list(self):
        cur_node = self.head
        while cur_node:
            print(cur_node.data)
            cur_node = cur_node.next

    def append(self, data):
        new_node = Node(data)

        if self.head is None:
            self.head = new_node
            return

        last_node = self.head
        while last_node.next:
            last_node = last_node.next
        last_node.next = new_node

    def prepend(self, data):
        new_node = Node(data)

        new_node.next = self.head
        self.head = new_node

    def insert_after_node(self, prev_node, data):

        if not prev_node:
            print("Previous node is not in the list")
            return

        new_node = Node(data)

        new_node.next = prev_node.next
        prev_node.next = new_node
```



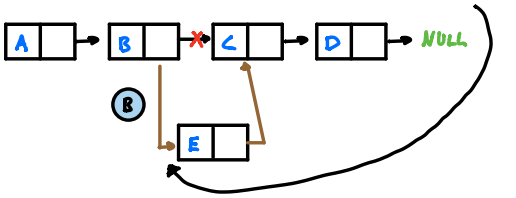
Going to pass in a previous node, where we would like to insert after

if given node doesn't Exist, We will just return

Create new node

(A) Setting pointer of our new node to next node

(B) The Previous node now needs to point to our new node




```
llist = LinkedList()
llist.append("A")
llist.append("B")
llist.append("C")
llist.append("D")


llist.insert_after_node(llist.head.next, "E")

llist.print_list()
```

This is node B

```
A
B
E
C
D
```