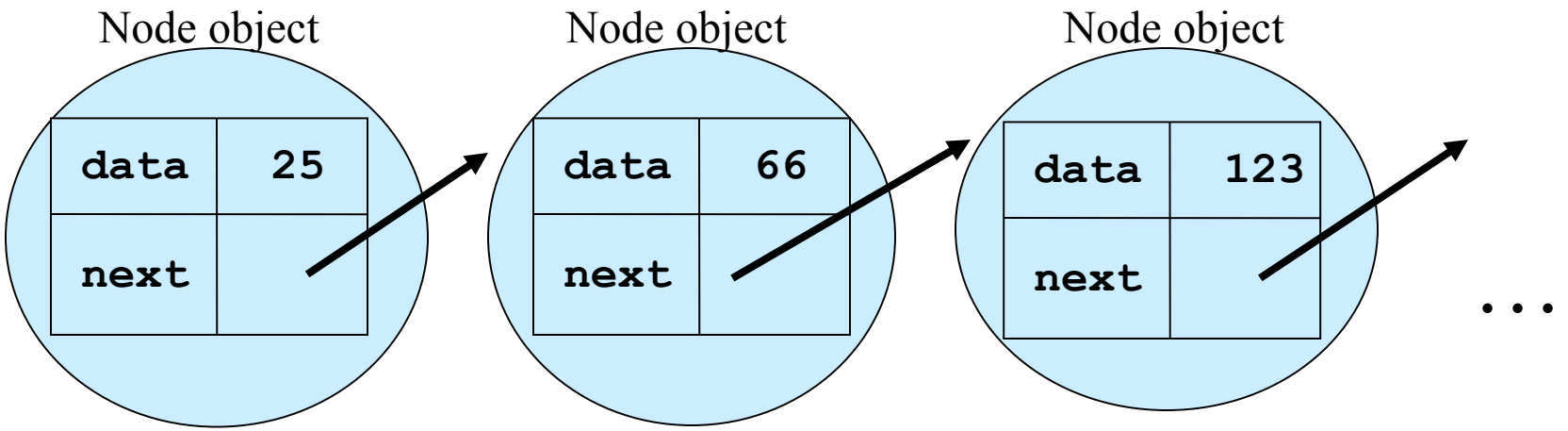
Linked Structures

- Self-referential classes can be used to create linked data structures:

```
class Node:
    def __int__(self, data, next):
        self.data = data
        self.next = next
    def getNext(self):
        return self.next
    def getData(self):
        return self.next
```

- **`next`** holds a reference to a Node object
- through the next reference, can link **`Node`** objects together:

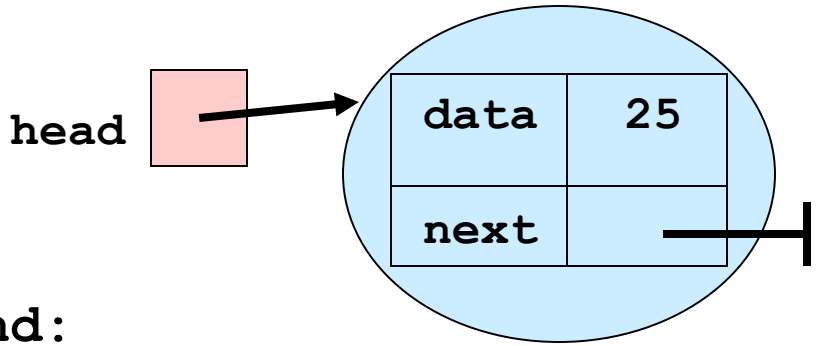


Linked List

- Ordered Collection of data
- Need a single variable which is reference to 1st node on list
- Nodes are linked together in-order by following **`next`** references

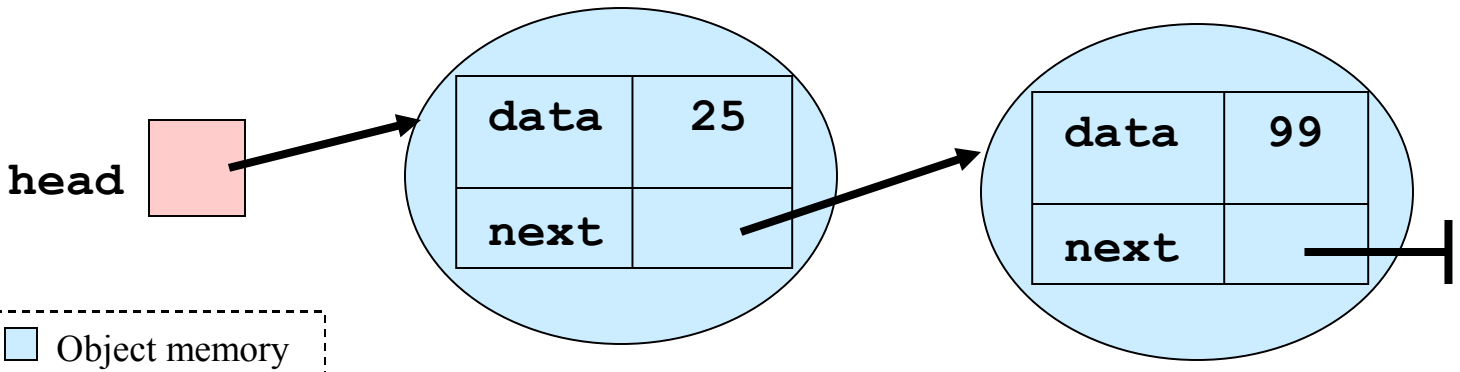
```
# an empty list:
head = None
# a list with one node:
head = Node(25, None)
```

List of length 1:




```
# add a second Node to the end:
head.setNext(Node(99, None))
```

List of length 2:



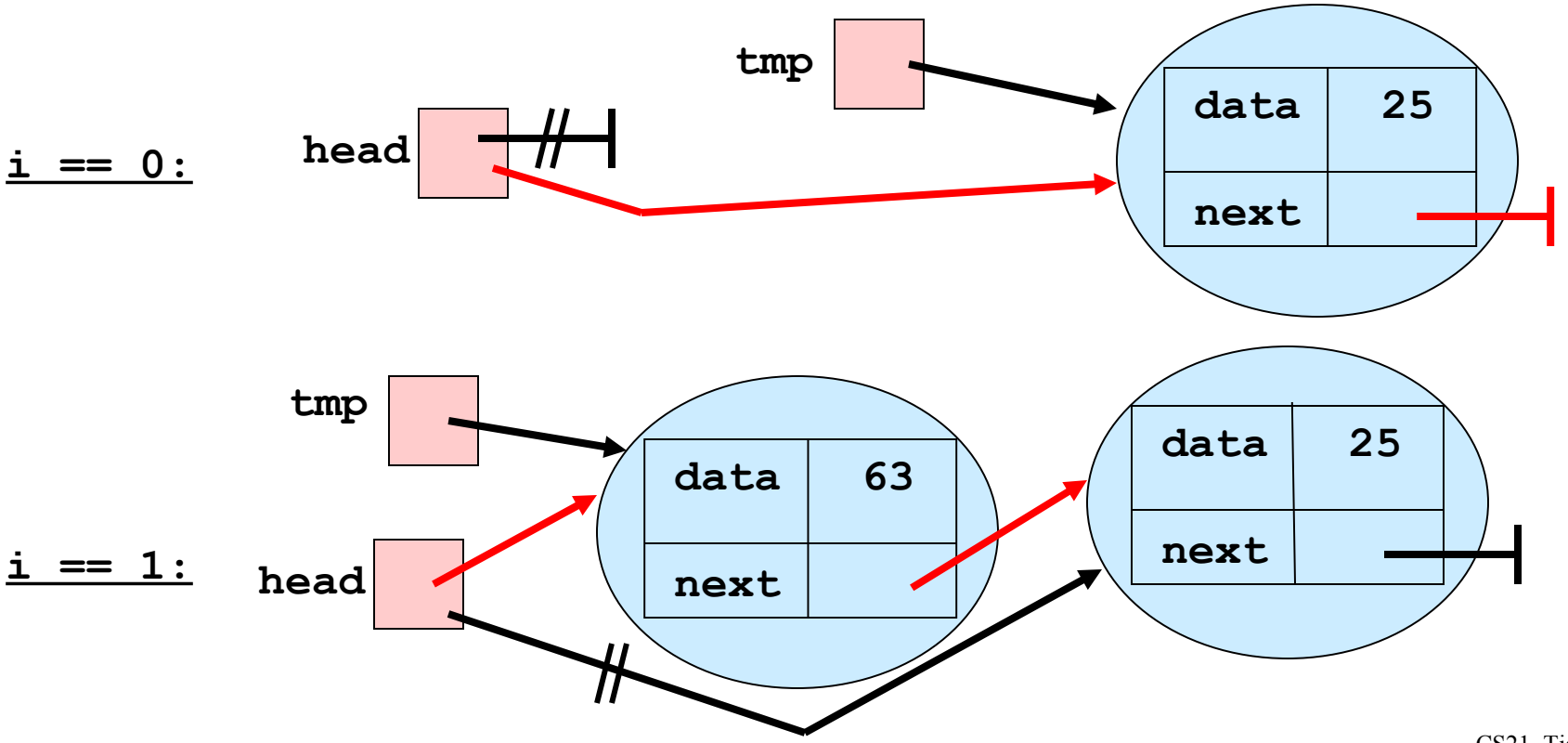
Stack memory Object memory

Operations on a List

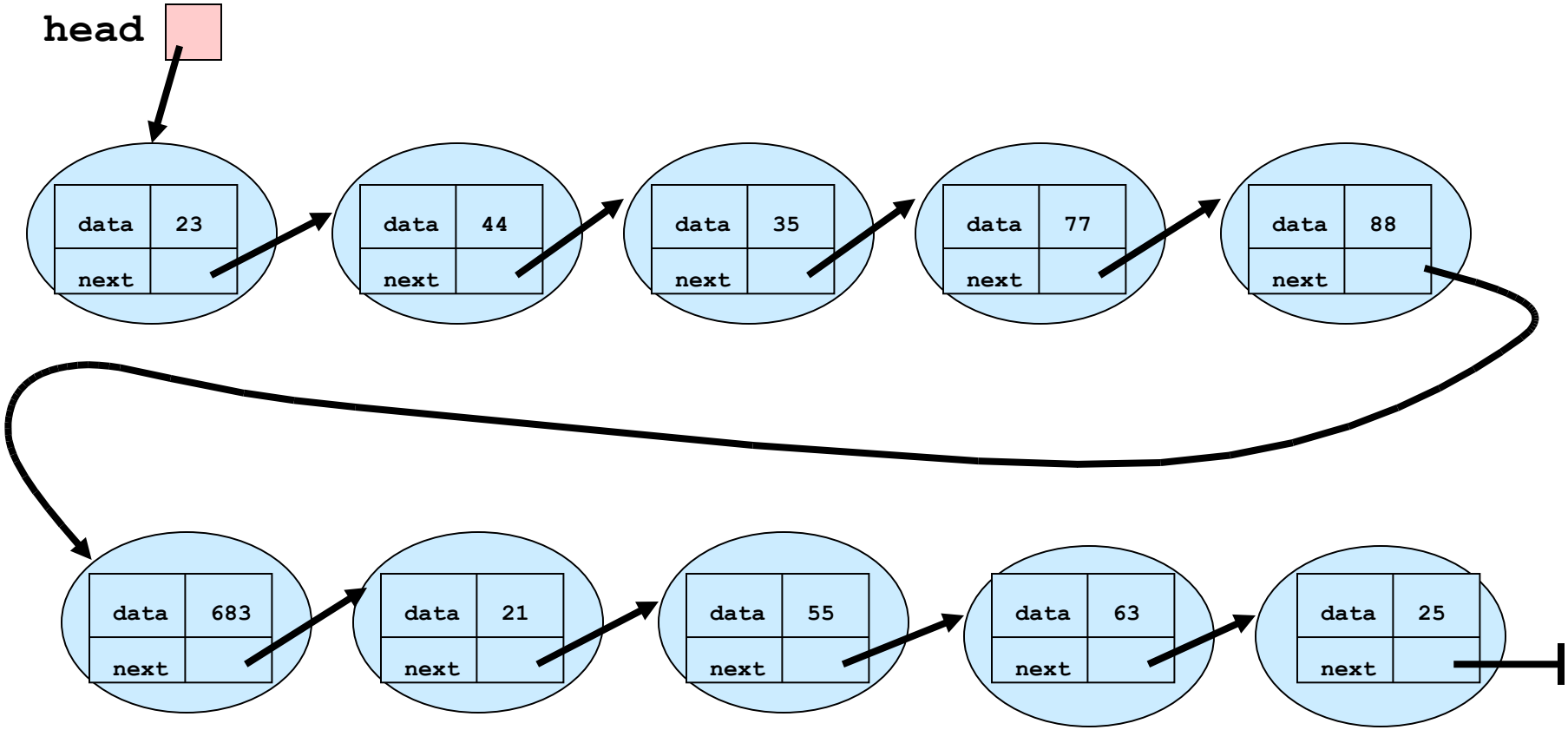
- All start at Node referred to by head reference, and traverse next references to access other nodes in the list
- Accessing the ith node is O(n):
  - first access Node referred to by head,
    follow its next reference to access the 2nd Node,
    follow its next reference to access the 3rd Node,
    and so on

Insert at Head of List

```
head = None
For i in range(10): // make list of 10 Nodes
    val = input("Enter a value: ")
    tmp = Node(val, None)
    tmp.setNext(head)
    head = tmp
```

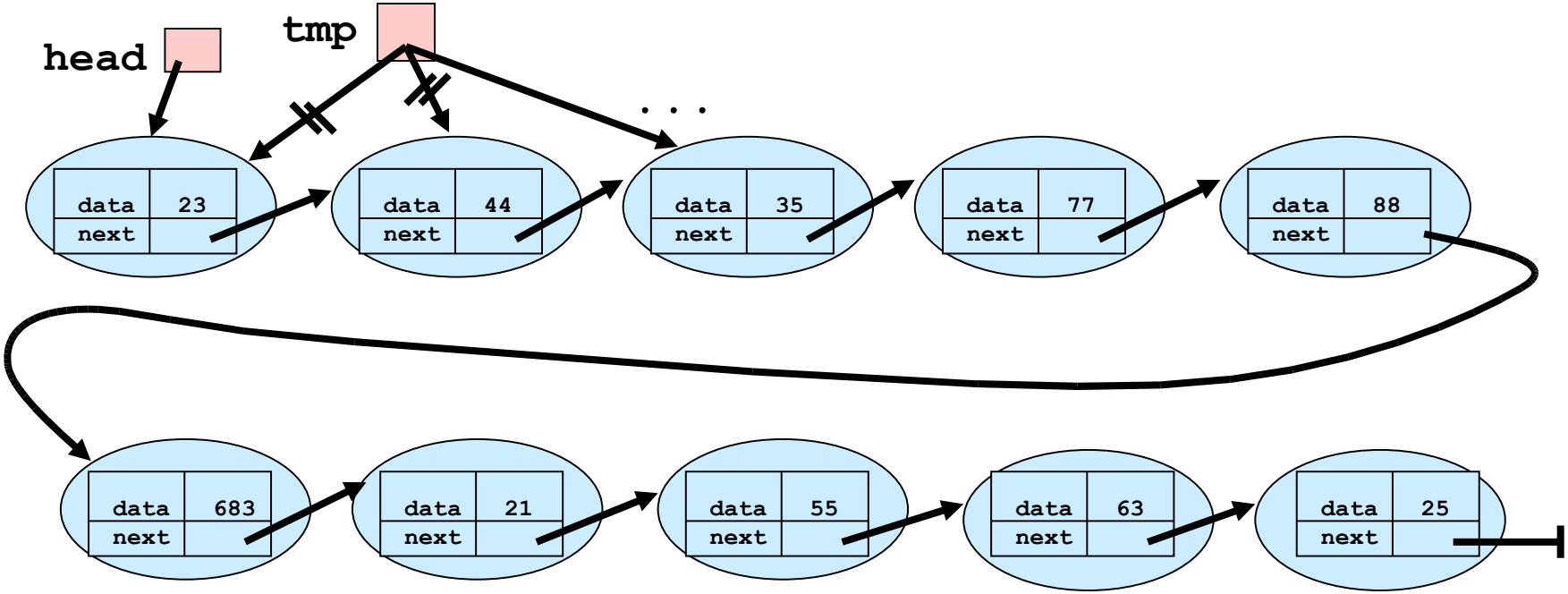


Resulting List of 10 nodes:



Traverse the List

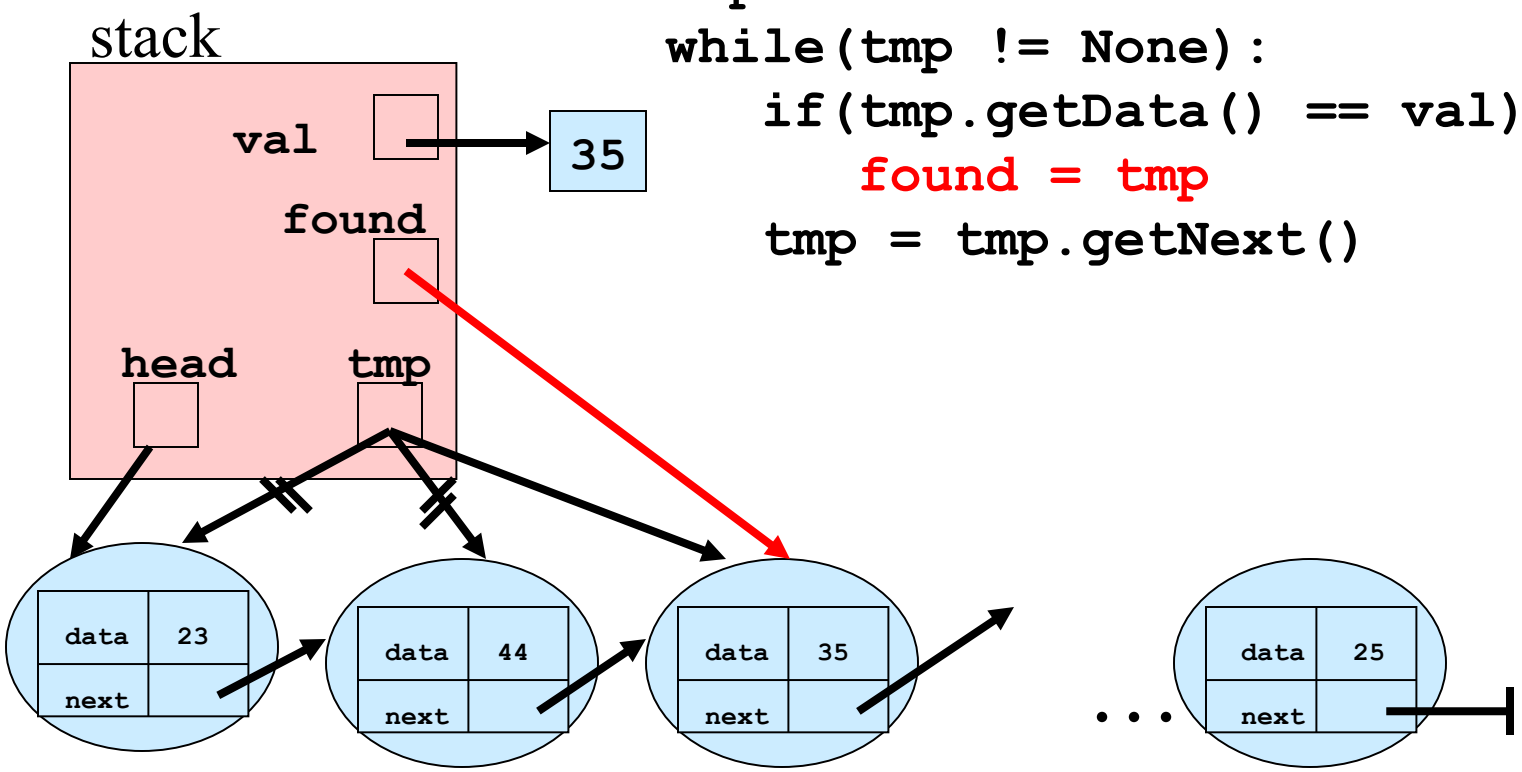
```
tmp = head    # start at the 1st node
while(tmp != None):
    # print out value of the data field of curr node
    print (tmp.getData() + " ")
    # set tmp to point to the next Node in the list
    tmp = tmp.getNext()
# output:  23 44 35 77 88 683 21 55 63 25
```



Find Element In List

- Start at head Node, compare search value to data field
- traverse next refs until matching data field is found, or until no more list

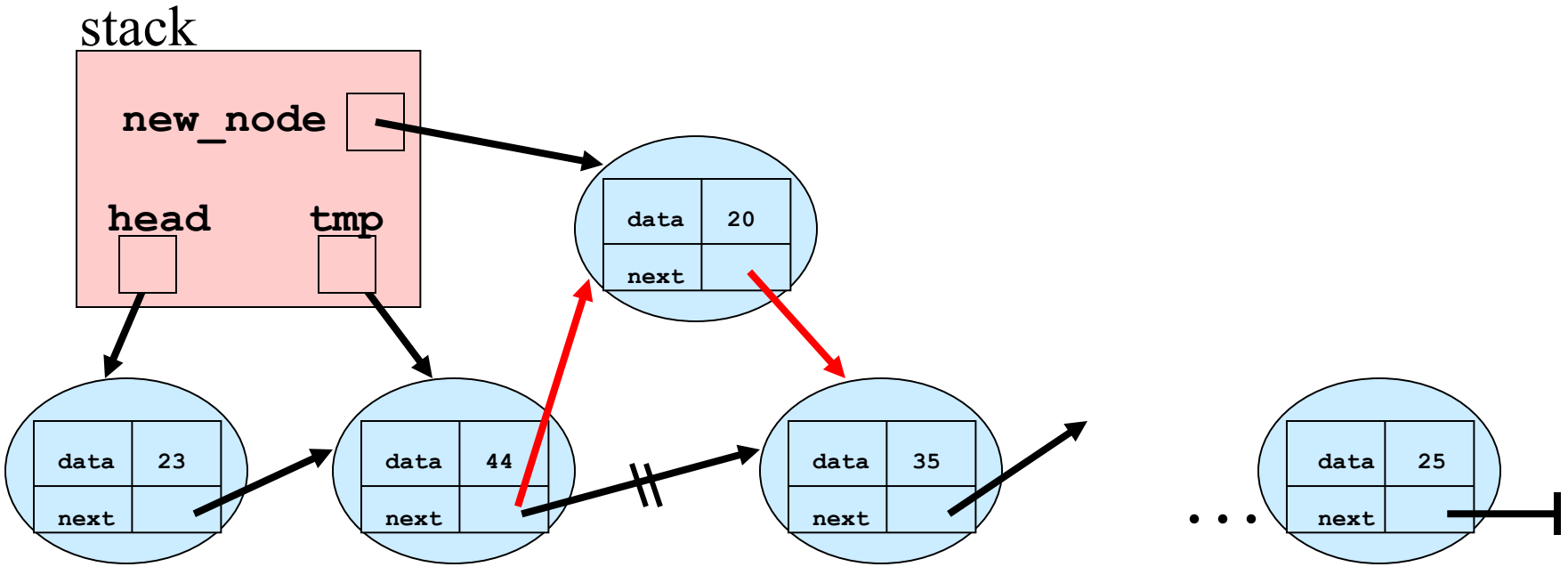
```
# found will pt to matching Node
found = None
tmp = head
while(tmp != None):
    if(tmp.getData() == val):
        found = tmp
    tmp = tmp.getNext()
```



Insert in the middle

```
new_node = Node(20, None)
tmp = head.getNext()   # lets just make tmp point
                       # to some Node after head

# insert new_node after tmp
new_node.setNext(tmp.getNext())
tmp.setNext(new_node)
```



LinkedList Class

- Would really write and use a LinkedList class that encapsulates all data and method functions associated with a linked list:

```
class LinkedList:
    def __init__(self): # create an empty list
        self.head = None
        self.size = 0
    def insertAtHead(self, data):
        new_node = Node(data, None)
        new_node.setNext(self.head)
        self.head = new_node
        self.size = self.size + 1
    # and more method definitions for linked
    # list operations . . .

def main(): # use the LinkedList class
    my_list = LinkedList()
    my_list.insertAtHead(25)
```