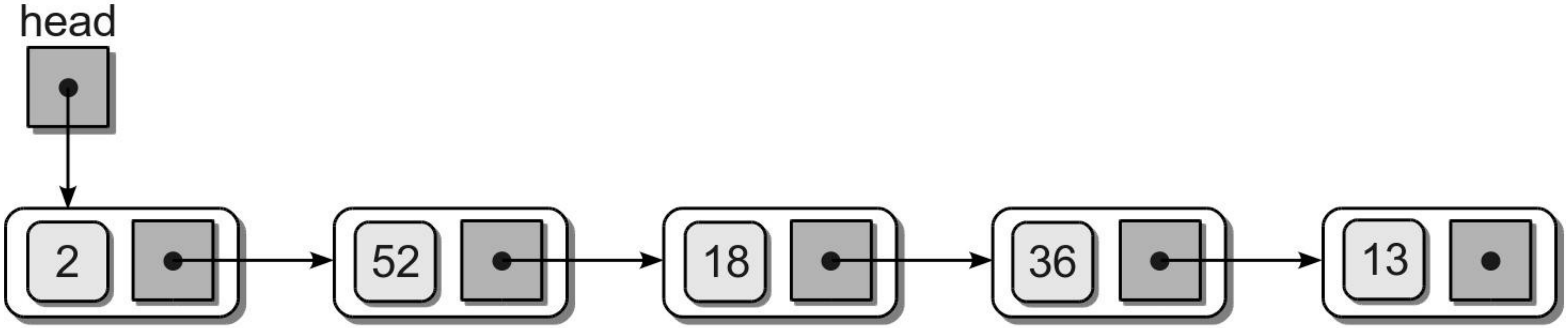
# Singly-Linked Lists

Modifications by Nathan Sprague

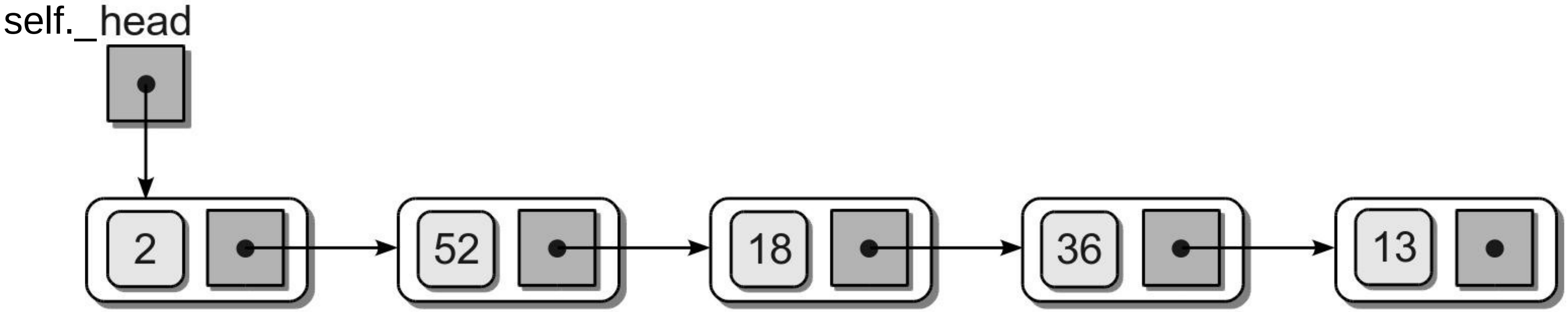
# Linked Structure

- Constructed using a collection of objects called **nodes**.
- Each node contains data and at least one reference or **link** to another node.
- **Linked list** – a linked structure in which the nodes are linked together in linear order.



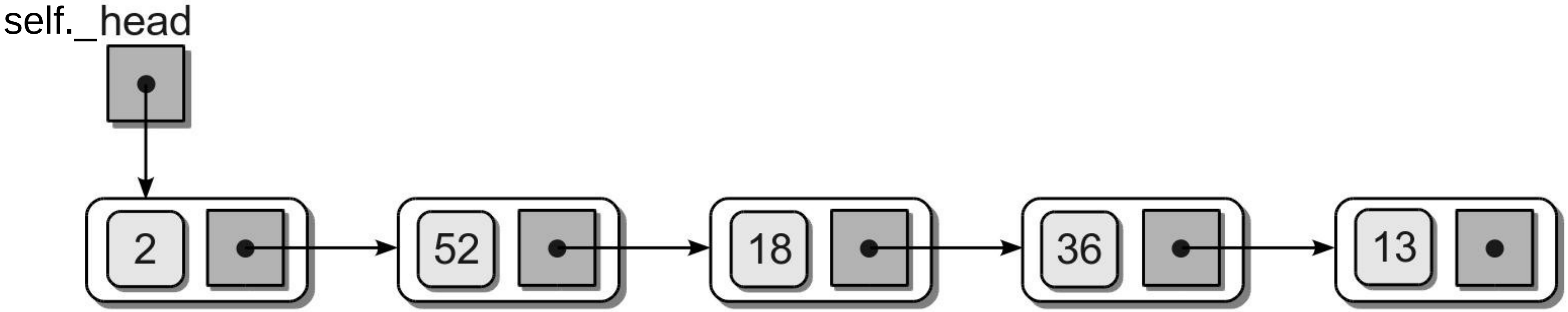
# Linked List

- Terms:
  - **head** – first node in the list.
  - **tail** – last node in the list; link field has a null reference.



# Linked List

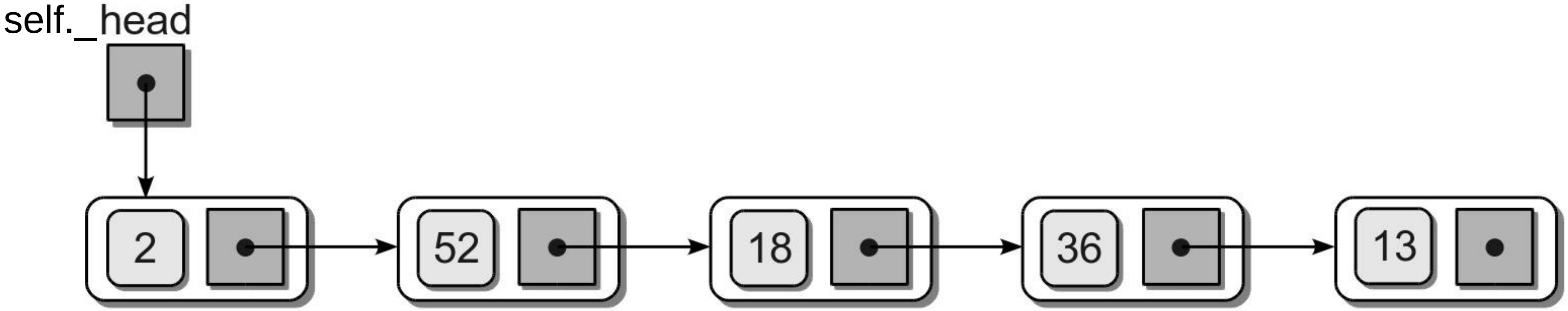
- Most nodes have no name; they are referenced via the link of the preceding node.
- **head reference** – the first node must be named or referenced by an external variable.
  - Provides an entry point into the linked list.
  - An empty list is indicated by a null head reference.



© 2011 John Wiley & Sons, Data Structures and Algorithms Using Python, by Rance D. Necaise.

# Singly Linked List

- A linked list in which
  - each node contains a single link field and
  - allows for a complete linear order traversal from front to back.



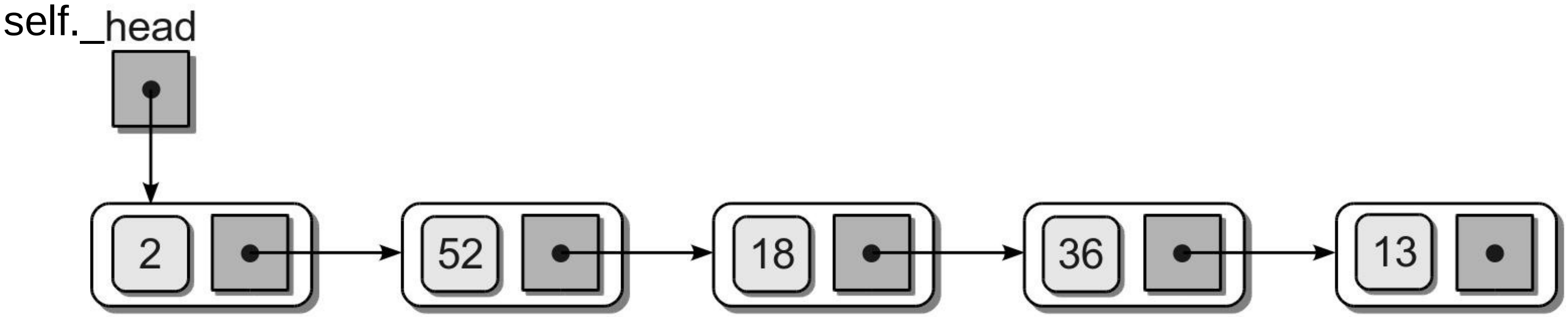
# Node Definition

- The nodes are constructed from a simple storage class:

```
class ListNode:
  def __init__(self, data, next_node):
    self.data = data
    self.next = next_node
```

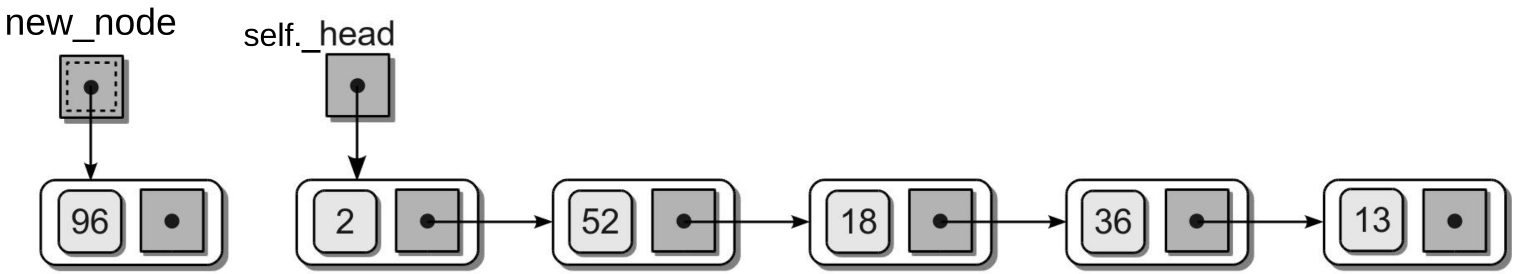
# Prepending Nodes

- **Example:** add value 96 to the sample list.

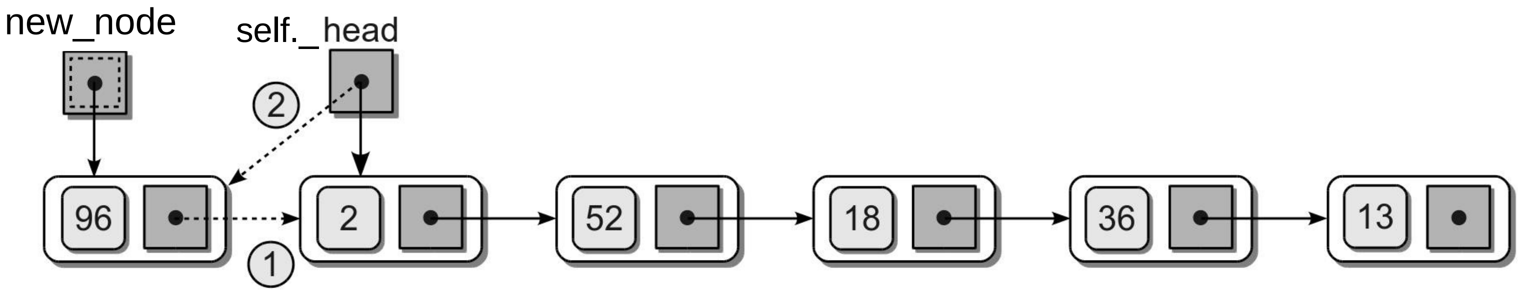


# Prepending Nodes

- Create a new node for the new item.

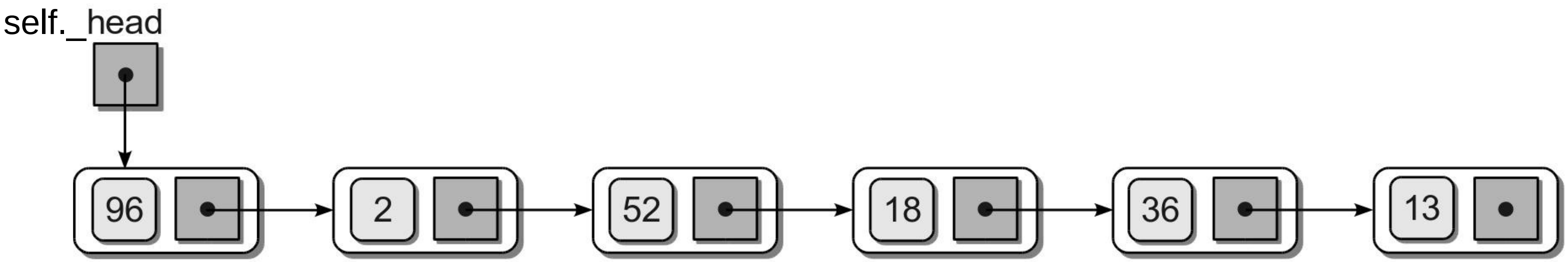


- Connect the new node to the list.



# Prepending Nodes

- The resulting list.

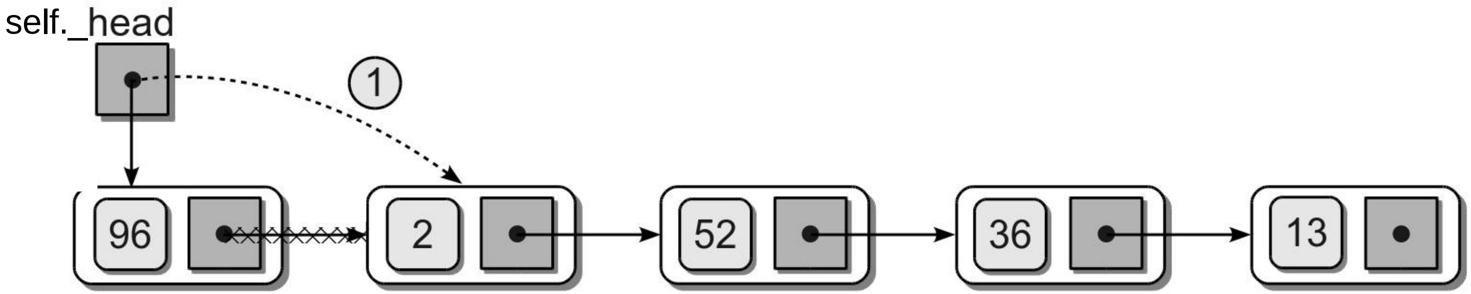


- Python code

```
# Given the head reference and the new item.
new_node = ListNode( new_item, self._head )
self._head = new_node
```

# Removing The First Node

- The head reference must be reposition to reference the next node in the list.

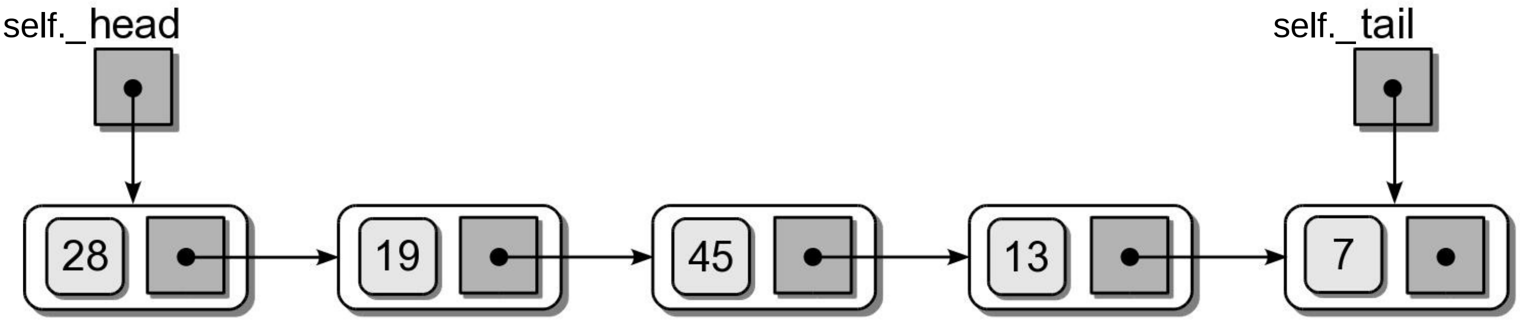


© 2011 John Wiley & Sons, Data Structures and Algorithms Using Python, by Rance D. Necaise.

# Linked Stack...

# Using a Tail Reference

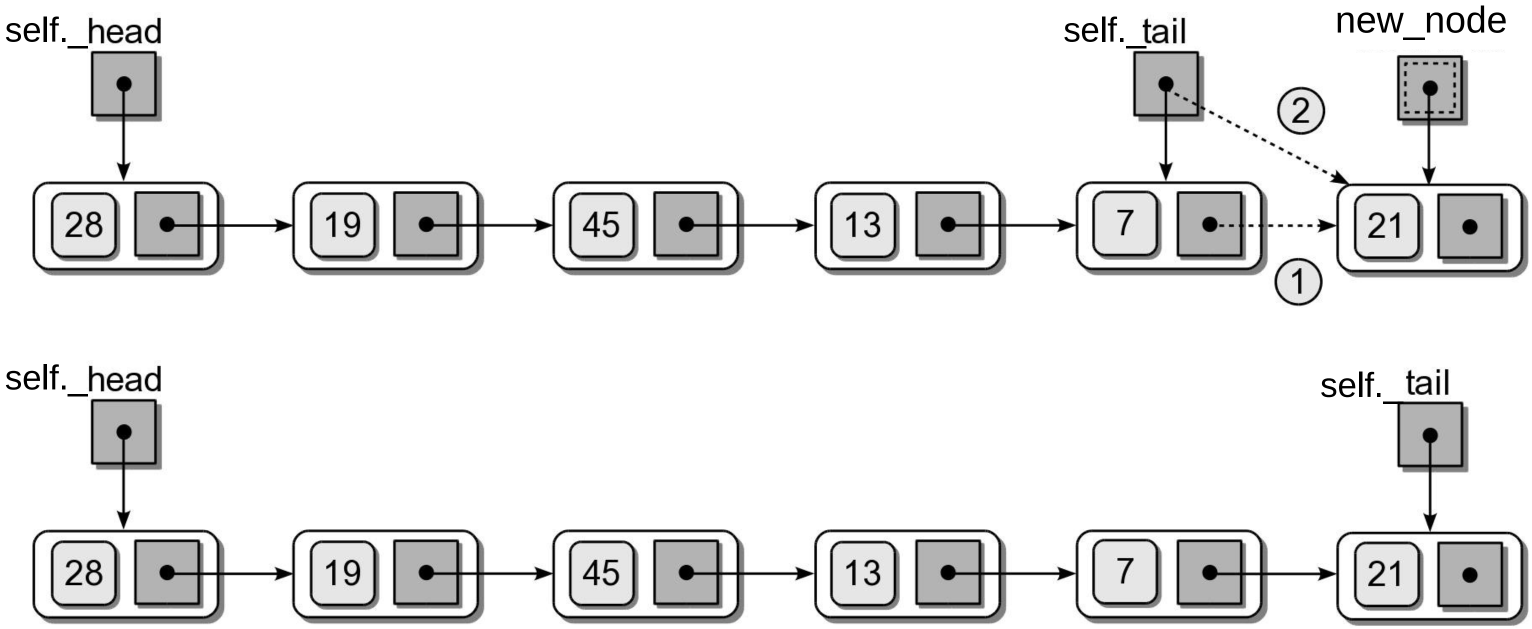
- Some applications require items be appended to the end of the linked list.
  - **tail reference** – a second external reference indicating the tail or last node in the list.



© 2011 John Wiley & Sons, Data Structures and Algorithms Using Python, by Rance D. Necaise.

# Appending Nodes

**Example**: append 21 to the list.



# Appending Nodes

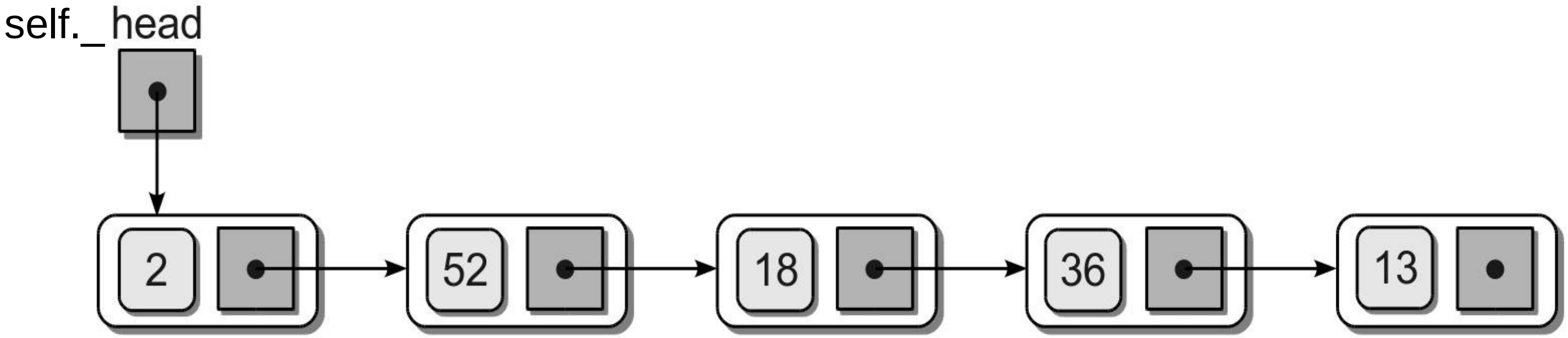
- Given the head and tail reference, we can add an item to a linked list.

```
new_node = ListNode(item, None)
if self._head is None: # list is empty
  self._head = new_node
else :
  self._tail.next = new_node
self._tail = new_node
```

# Linked Queue...

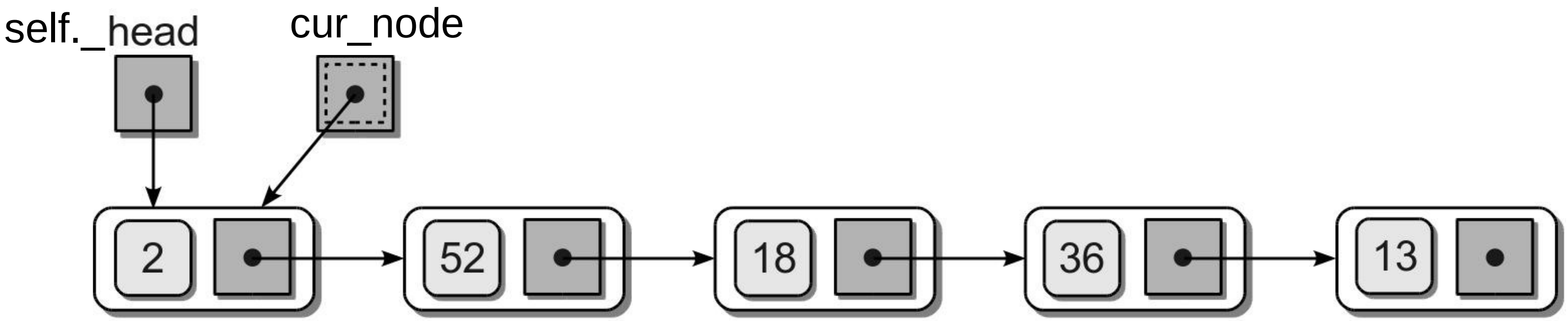
# Traversing the Nodes

- We can traverse the nodes using a temporary external reference variable.



self._head

  - Initialize a temporary reference to the head node.



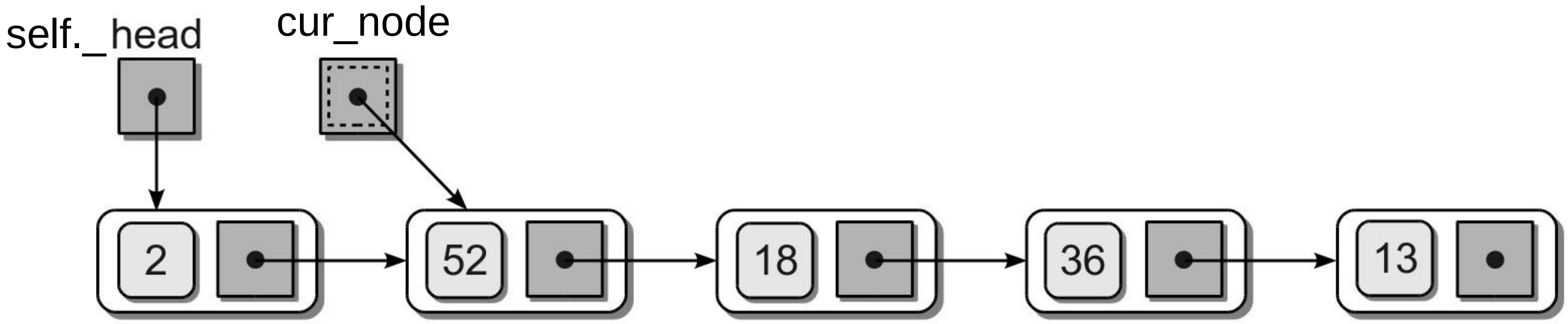
self._head

cur_node

  - Visit the node.

# Traversing the Nodes

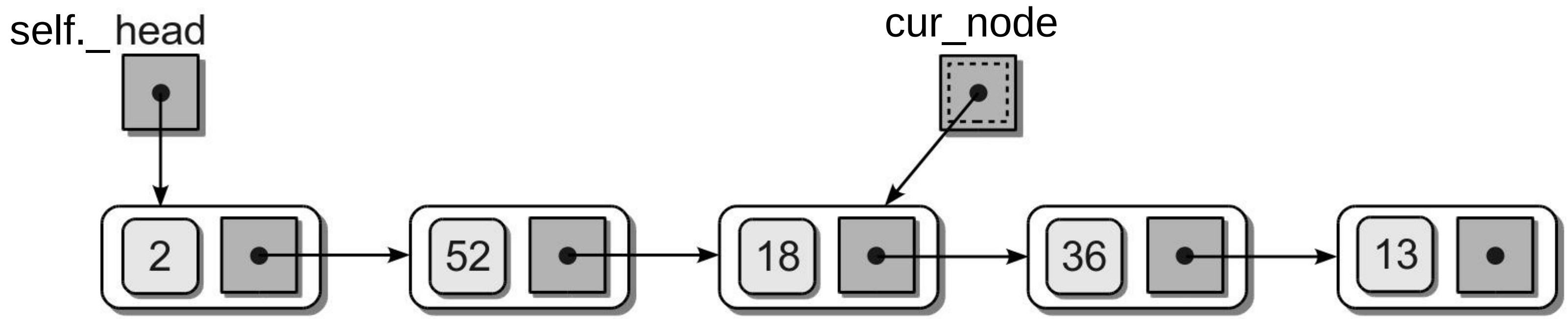
- Advance the temporary reference to the next node using the link field and visit that node.

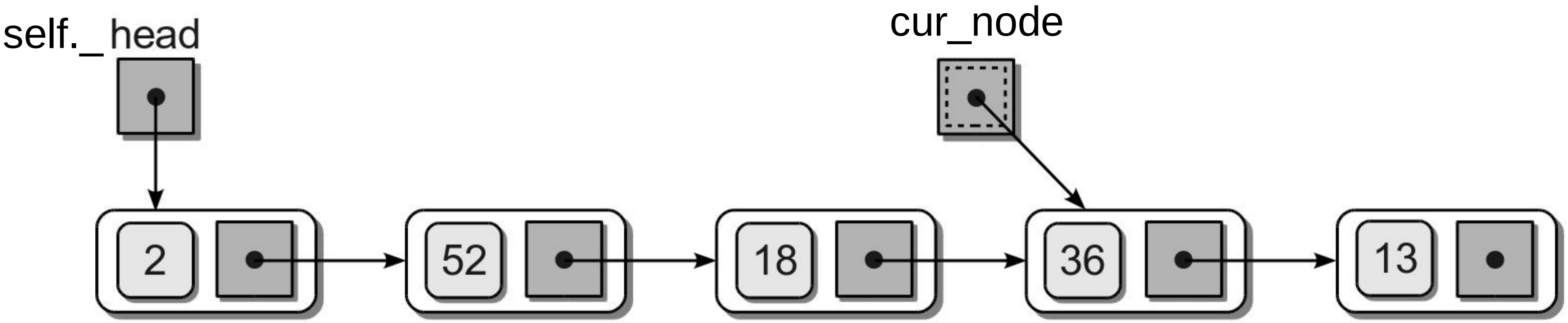


© 2011 John Wiley & Sons, Data Structures and Algorithms Using Python, by Rance D. Necaise.

# Traversing the Nodes

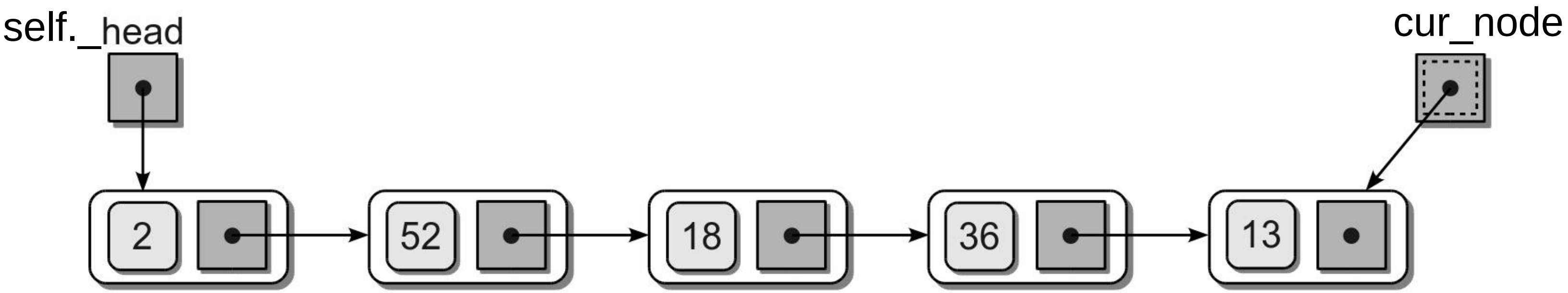
- Repeat the process until the reference falls off the end of the list.

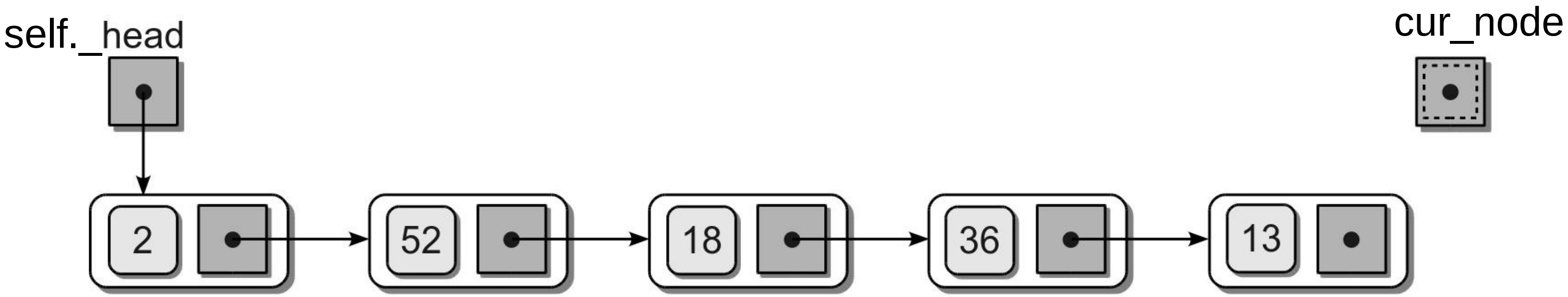




# Traversing the Nodes

- Repeat the process until the reference falls off the end of the list.





# Traversal Code

- Given the head reference, we can traverse the nodes.

```
def print_list(self):
  cur_node = self._head
  while cur_node is not None :
    print(cur_node.data)
    cur_node = cur_node.next
```