파이썬으로 배우는 데이터 구조

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학습 목표

ListUnsorted 클래스의 push(), pop(), find()
등 을 구현할 수 있다

Data Structures in Python
Chapter 3 - 3

- Linked List
- OOP Inheritance
- **ListUnsorted Class**
- ListSorted Class & Iterator

Agenda

- Linked List - Review
- ListUnsorted Implementation
  - ADT
  - Constructor
  - Traversal
  - push(), pop(), find()

Linked List ADT

- `LinkedList()`
  - Creates a new list that is empty and returns an empty list.
- `is_empty()`
  - Tests to see whether the list is empty and **returns** a Boolean value.
- `size()` and `__len__()`
  - Returns the number of nodes in the list.
- `__str__()`
  - Returns contents of the list in human readable format.
- `push(data)`
  - Pushes a new node with the data to the list.
- `pop(data)`
  - Removes the node from the list.
- `find(data)`
  - Searches for the data in the list and **returns** a Boolean value.

abstract methods

The ListUnsorted Class - ADT

- `ListUnsorted(): __init__()`
  - Creates a new list that is empty and returns an empty list.
- `push(data)`
  - Pushes a new node to the list at the front. O(1)
- `push_back(data)`
  - Pushes a new node to the list at the back. O(n)
- `pop(data)`
  - Removes the node with data from the list.
- `find(data)`
  - Searches for the data in the list and returns a Boolean value.

The ListUnsorted Class - ADT

- The linked list is built from a collection of nodes, each linked to the next by explicit references.
  - It must maintain a reference to the first node (head).
  - It is commonly known as a **linked list**.
- Examples:
  - An Empty List:

```
mylist = ListUnsorted()
```

The ListUnsorted Class - Constructor

- To use the abstract methods, import The constructor contains
  - A **head** reference variable
    - References the list's first node
    - Always exists even when the list is empty

```
from abc import ABC, abstractmethod

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

```
class ListUnsorted(LinkedList):
    def __init__(self):
        LinkedList.__init__(self)
    ...
```

```
if __name__ == '__main__':
    mylist = ListUnsorted()
```

The ListUnsorted Class

- Example: a linked list of integers

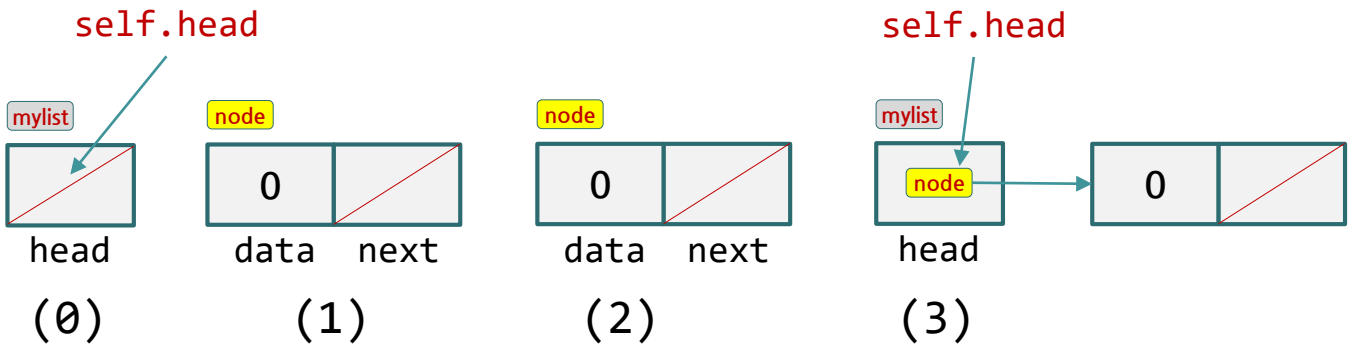
```
class ListUnsorted(LinkedList):
    ...

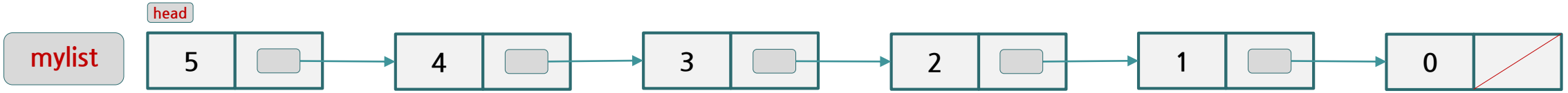
    def push(self, data):
        node = Node(data)
        node.set_next(self.head)
        self.head = node
    ...
```

(1)
(2)
(3)

```
if __name__ == '__main__':
    mylist = ListUnsorted()
    for i in range(6):
        mylist.push(i)
```

(0)





The ListUnsorted Class

- Example: a linked list of integers

```
class ListUnsorted(LinkedList):
    ...

    def push(self, data):
        node = Node(data)
        node.set_next(self.head)
        self.head = node
    ...
```

(1) (2) (3)

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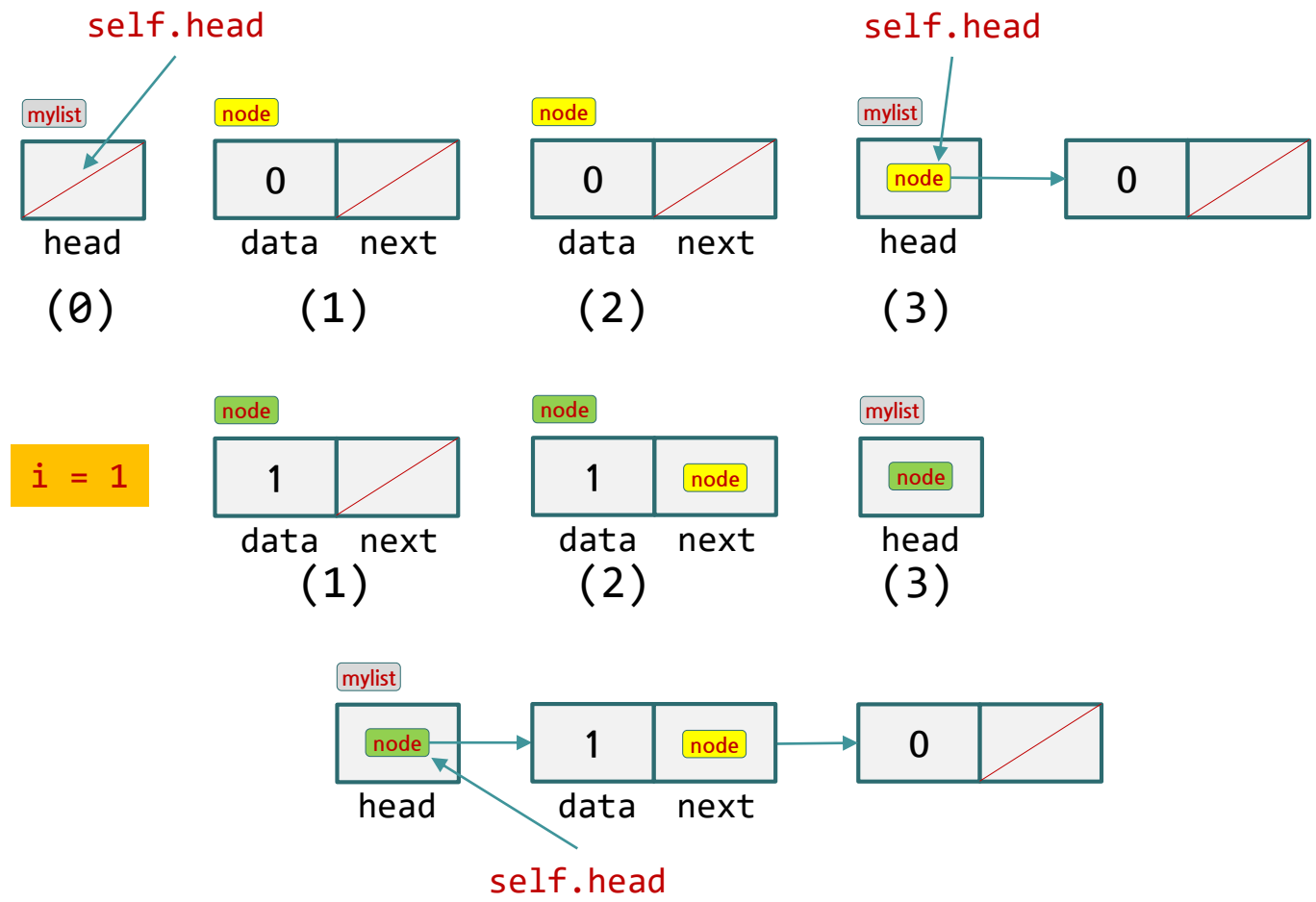
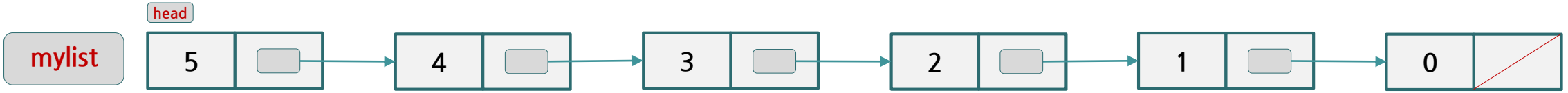
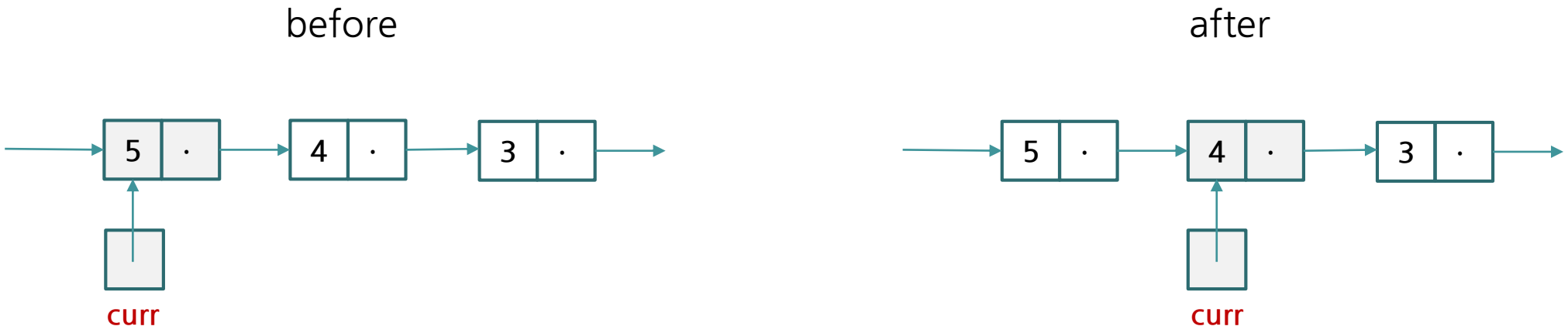




The ListUnsorted Class - Traversals

- To traverse a linked list, set a pointer to be the same address as **head**, process the data in the node, move the pointer to the **next** node, and so on.



The ListUnsorted Class - Traversals

- Loop stops when the next pointer is **None**
  - Use a reference variable: curr
    - References the current node
    - Initially references the first node (head)

```
curr = self.head
```

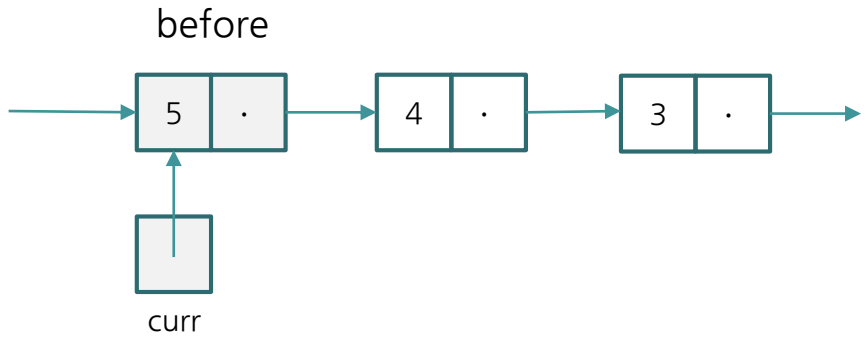
    - To advance the current position to the next node

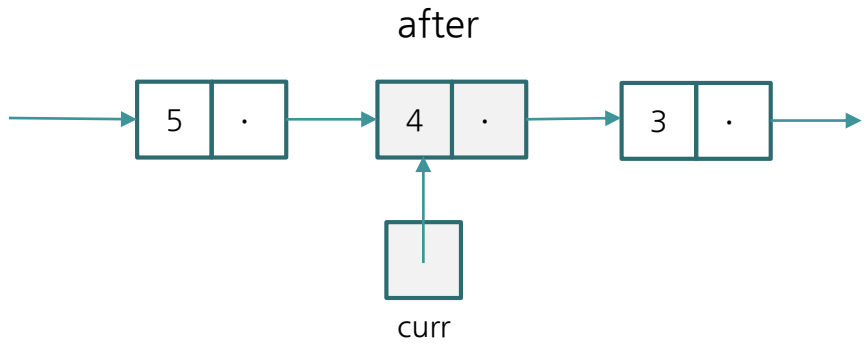
```
curr = curr.get_next()
```

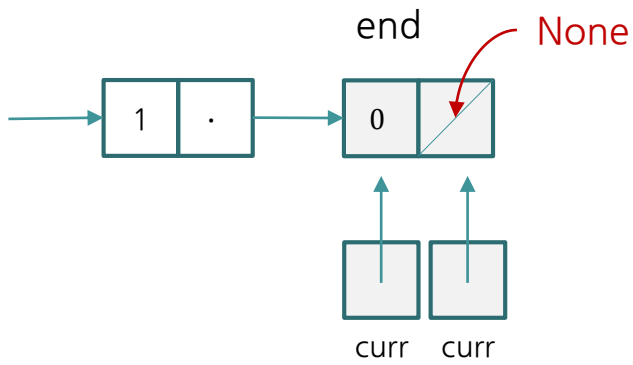
    - Loop

```
curr = self.head
while not curr == None:
    ...
    curr = curr.get_next()
```

after while loop, curr == None







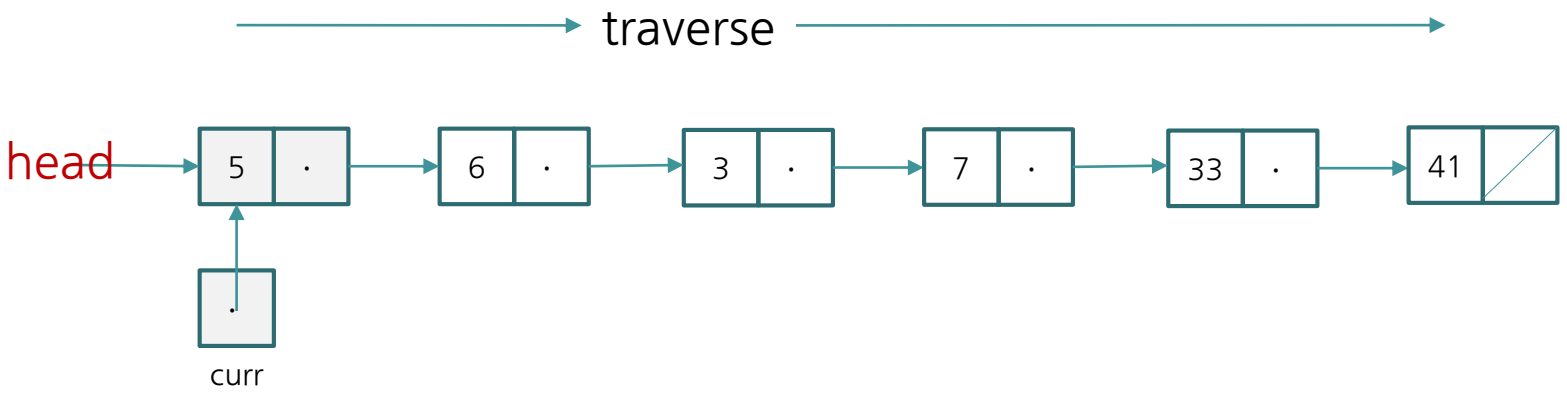
The ListUnsorted Class - Displaying the Contents

- Traversing the Linked List from the **head** to the **tail**
  - Use a reference variable: **curr**
  - This functionality may be implemented in **LinkedList.__str__()**

```
curr = self.head
while curr != None:
    print(curr.get_data(), end=' ')
    curr = curr.get_next()
```

```
5 6 3 7 33 41
```

after while curr == None



The ListUnsorted Class - is_empty() & size()

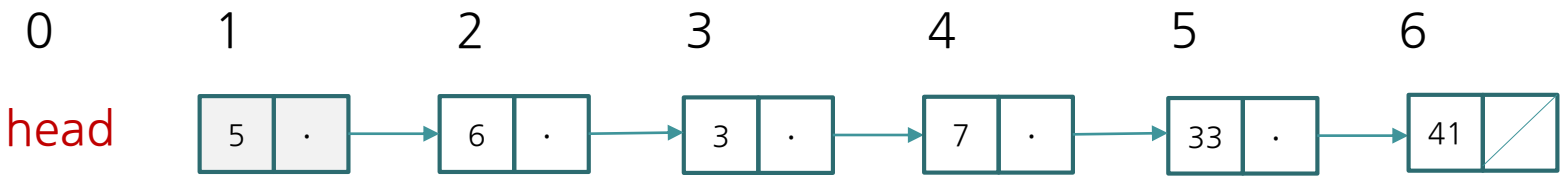
These methods may be implemented in `LinkedList` class.

- `is_empty()` - Tests to see whether the list is empty.

```
return self.head == None
```

- `size(), __len__()`
  - Returns the number of nodes in the list.
  - Traverses the list and counts the number of nodes.

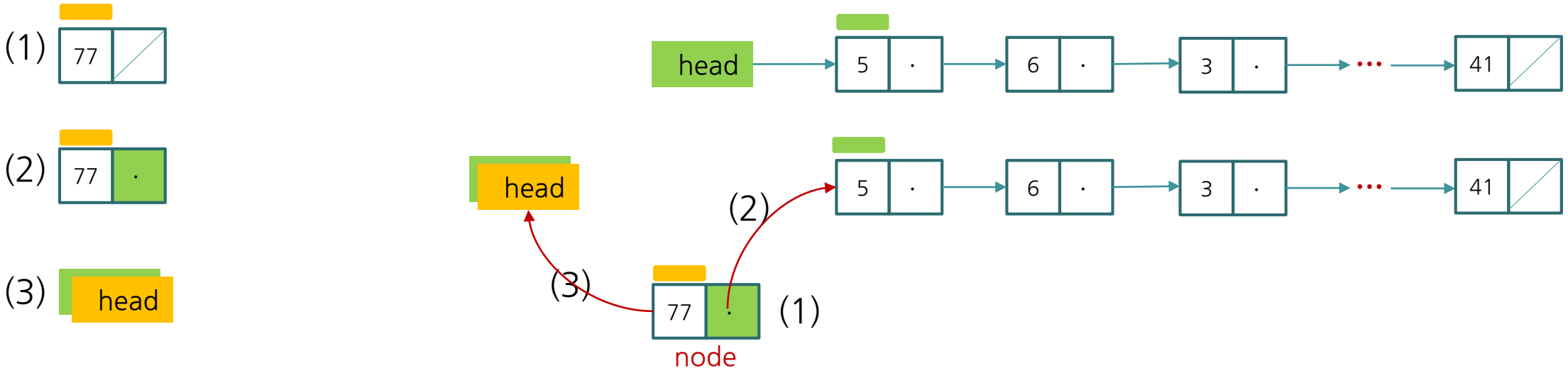
```
curr = self.head
count = 0
while curr != None:
    count = count + 1
    curr = curr.get_next()
```



The ListUnsorted Class - push()

- Push(data) inserts a node with data at the beginning of a linked list
  - Create a new Node and store the new data into it.
  - Connect the new node to the linked list by changing references.
    - Change the next reference of the new node to refer to the old first node of the list.
    - Modify the head of the list to refer to the new node.

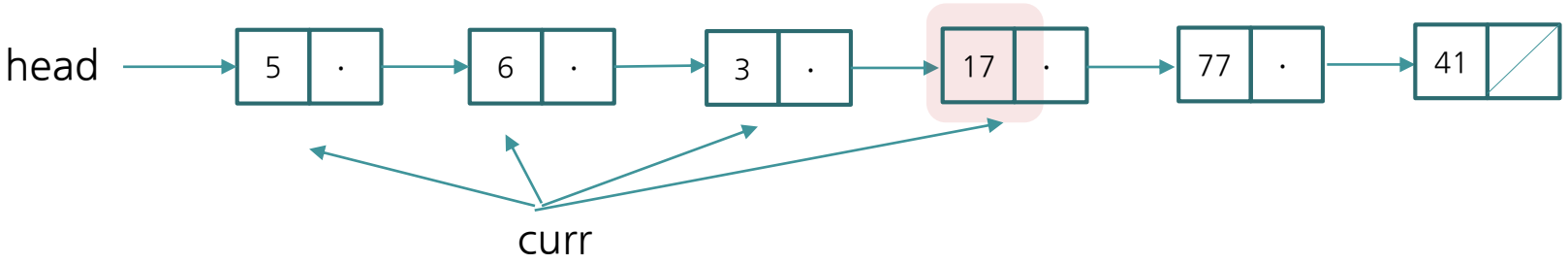
```
(1) node = Node(77)
(2) node.set_next(self.head)
(3) self.head = node
```



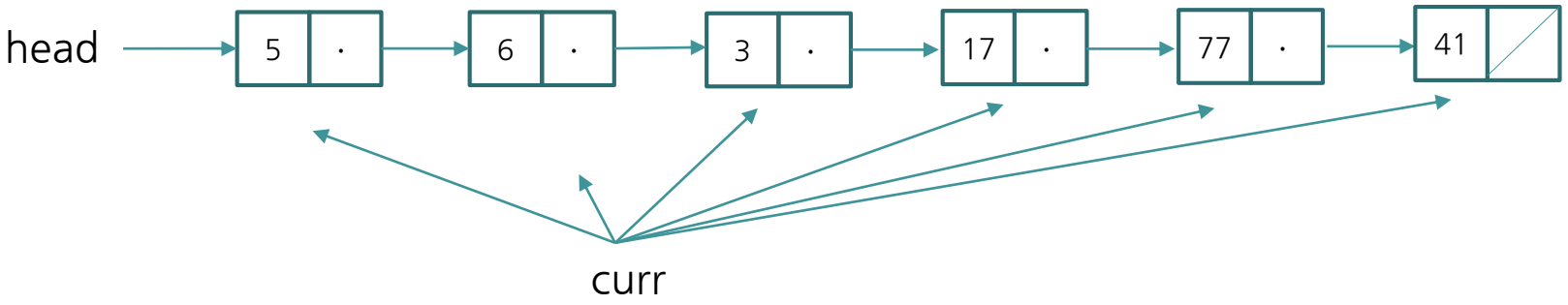
The ListUnsorted Class - find()

- find(data) searches for a node with data in the list and returns a Boolean.
- Examples:

```
print(mylist.find(17))
```




```
print(mylist.find(19))
```



The ListUnsorted Class - find()

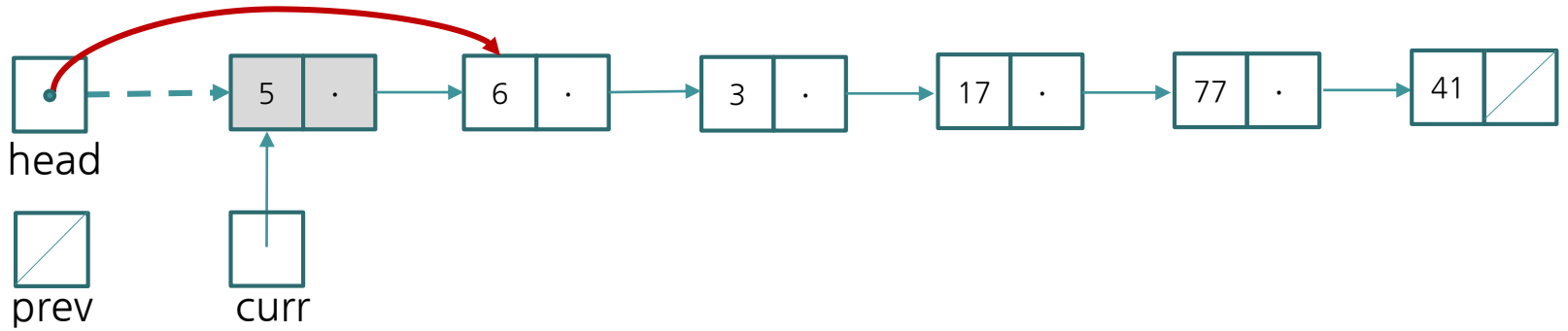
- To find a node in a linked list:
  - Set a pointer to be the same address as head.
  - Process the data in the node, move the pointer to the next node, and so on.
  - Loop stops either
    - The data is found.
    - The next pointer is None.

```
def find(self, data):
    curr = self.head
    while curr != None:
        if curr.get_data() == data:
            return True
        curr = curr.get_next()
    return False
```

The ListUnsorted Class - pop()

- pop(data) removes a node with data from the list.
  - Assume the node to pop is present in the list.
- Examples:
  - Case 1: Delete the first node.

```
mylist.pop(5)
```



  - Case 2:

The ListUnsorted Class - pop()

- pop(data) removes a node with data from the list.
  - Assume the node to pop is present in the list.
- Examples:
  - Case 1: Delete the first node.

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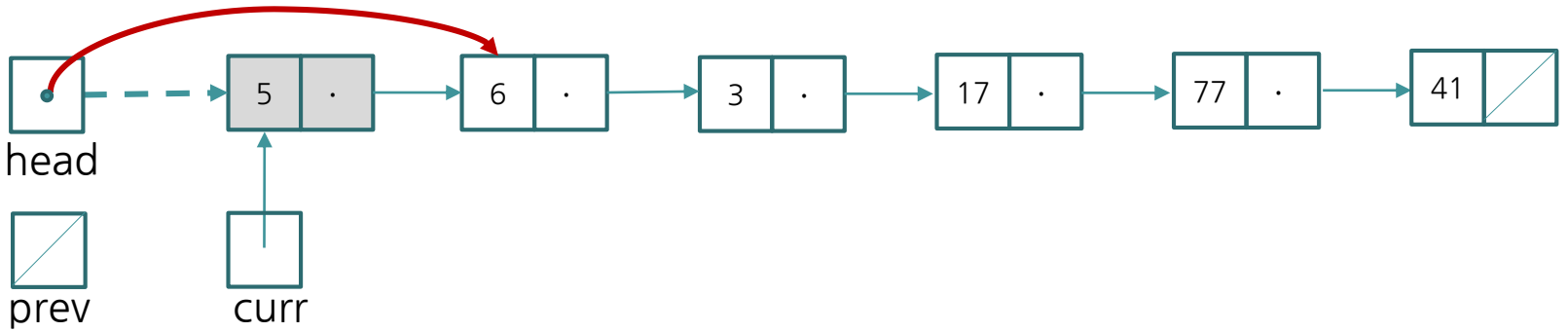
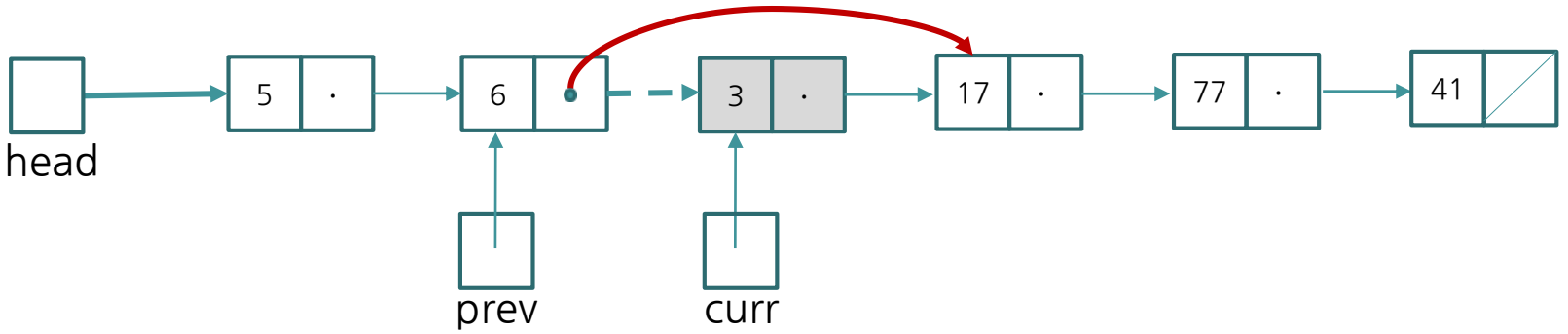
```



  - Case 2: Delete a node in the middle of the list with **prev** and **curr** references.

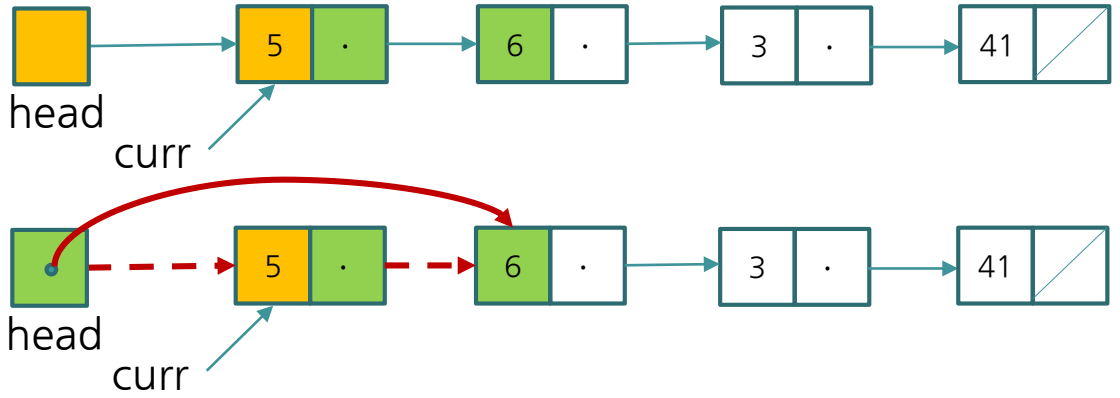
```
mylist.pop(3)
```



The ListUnsorted Class - pop()

- To delete a node from a linked list
  - Locate the node that you want to delete (**curr**)
  - **Disconnect** this node from the linked list by changing references.
- Two situations:
  - (1) To delete the **first** node,
    - Modify head to refer to the node after the current node

```
self.head = curr.get_next()
```



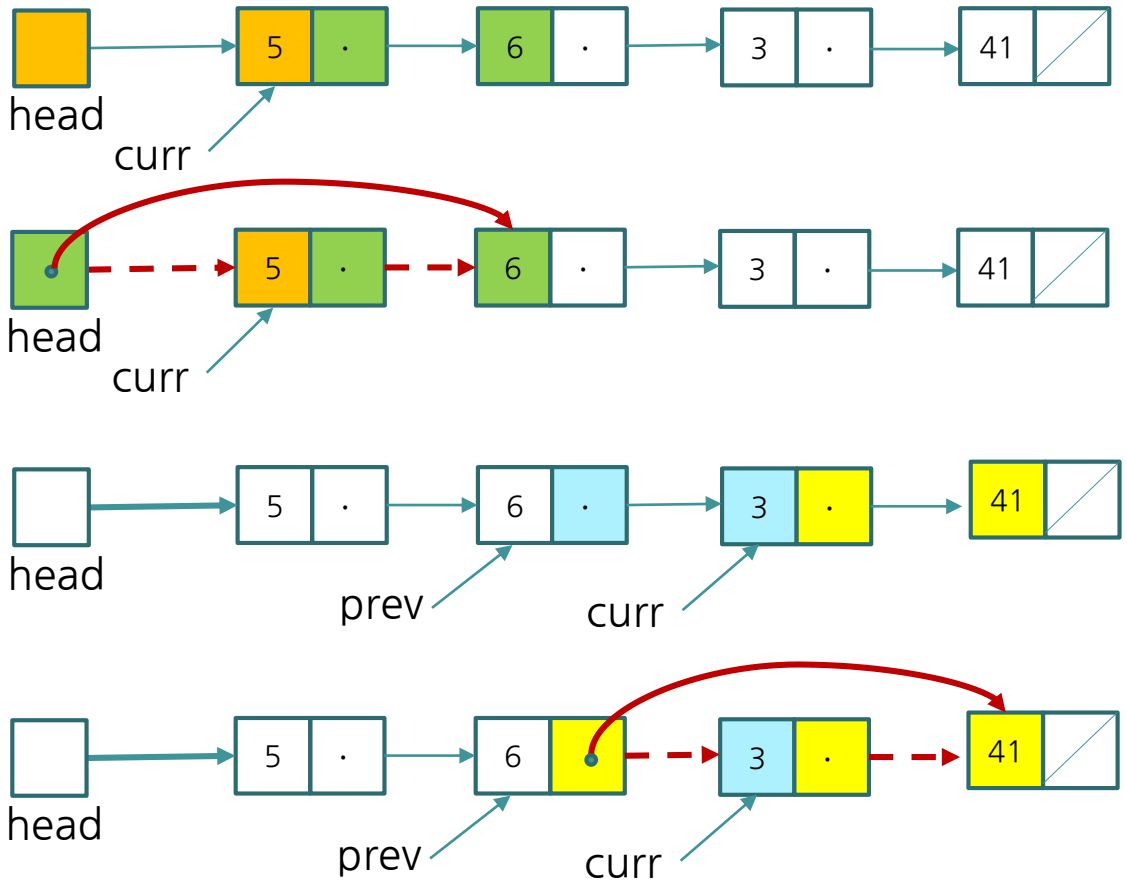
The ListUnsorted Class - pop()

- To delete a node from a linked list
  - Locate the node that you want to delete (**curr**)
  - **Disconnect** this node from the linked list by changing references.
- Two situations:
  - (1) To delete the **first** node,
    - Modify head to refer to the node after the current node

```
self.head = curr.get_next()
```

  - (2) To delete a node in the **middle,**
  - Set next of the **prev** node to refer to the node **after the current node.**

```
prev.set_next(curr.get_next())
```



The ListUnsorted Class - Example

- Example:

```
def TestListUnsorted():
    mylist = ListUnsorted()
    number_list = [31, 77, 17, 93, 26, 54]
    for num in number_list:
        mylist.push(num)

print (mylist.size())
print (mylist.find(17))
print (mylist.find(1))
mylist.pop(31)
mylist.pop(54)
print (mylist.size())
```

```
6
True
False


4
```

Summary

- Any element in a list can be accessed; however, you must traverse a linked list to access a particular node.
- A node can be inserted into and deleted from a reference based linked list without shifting nodes.

학습 정리

1) ListUnsorted 클래스에서 push()는 보통 reference를 덮어쓰는 방식이다

2) ListUnsorted 클래스에서 pop()을 구현할 때, 이전 노드의 reference가 필요할 수도 있으니 미리 저장해야 한다

3) LinkedList 에서는 노드를 추가하거나 삭제해도 기존의 노드들을 이동할 필요가 없다

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수고했습니다
곧 다음 시간에
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