Linked List, Stack, Queue

- What is the List
- Abstarct Data Type
- Array
- Array and List
- LinkedList
- Stack
- Queue

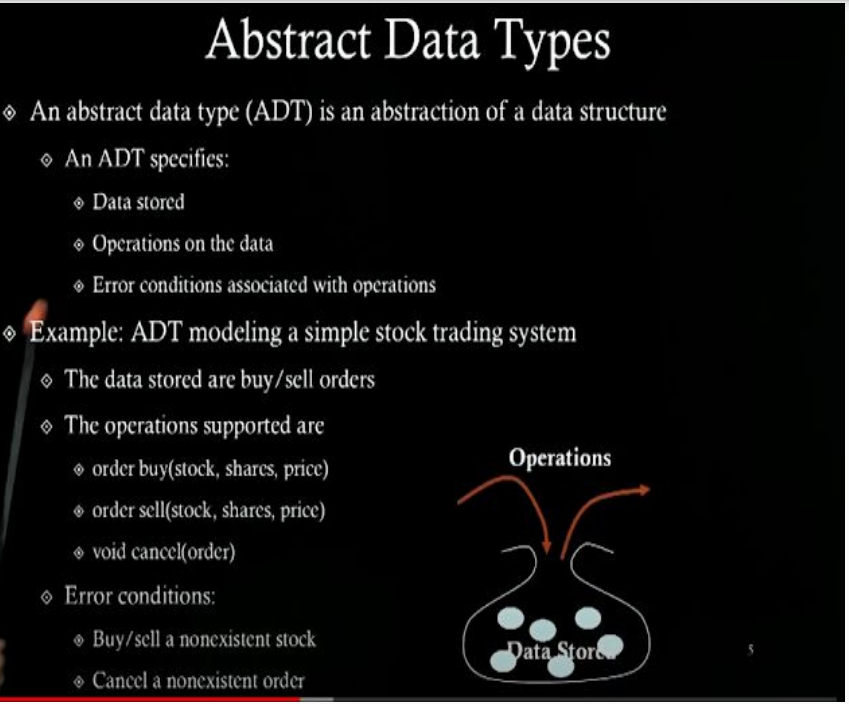
List

List는 왜 필요한가?
마구잡이로 엉켜있는 데이터를
선형적으로 정리하면 찾기가 쉬움

Scenario for List

- You are looking for Koh in the mass public
  - You are going to ask one by one "Are you Ms. Koh?"
  - Sometimes, you ask the question to a person multiple times
  - You realize that this is not going to work!
  - So, you line up the people and again ask the question one-by-one
- You are looking for a restroom on the floor
  - The floor has a long corridor, and every room has an entrance to the corridor
  - You only need to follow the corridor
- You have a dump of information of customers
  - How to store, search, and manipulate the information
- You line them up as a ***list***!

Abstract Data Type



Abstract Data Type 이란

데이터를 저장할 수 있고 데이터를 넣고 뺄 수 있으며 에러를 제어할 수 있는 자료구조를 뜻한다.

Array

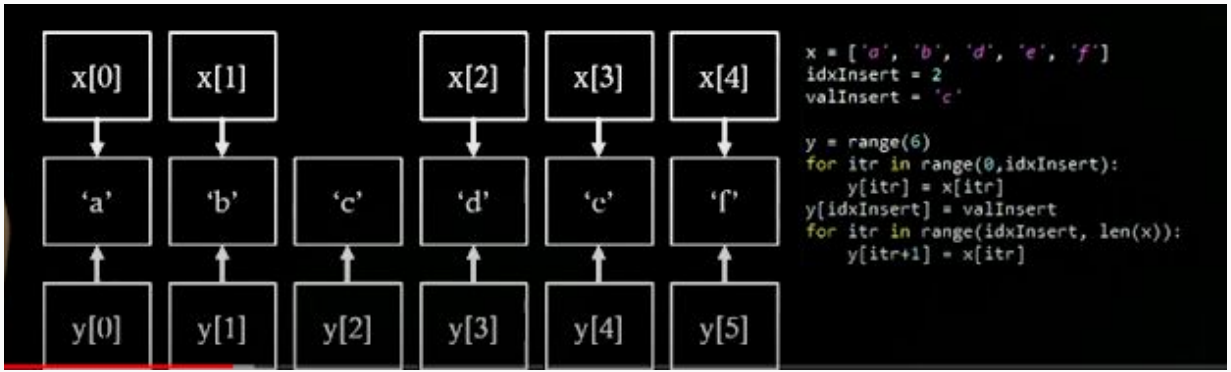
Array란?

동일한 데이터를 인덱스를 활용하여 저장할 수 있는것

다른 언어에서는 사이즈를 정하고 데이터 타입을 지정해줘야 하는데

파이썬에서는 List로 쉽게 구현할 수 있다.

Insert Procedure in array

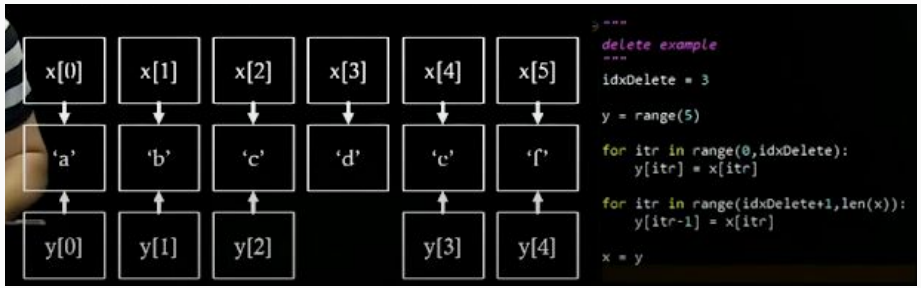


실행 수
a+1+n-a-1 = n

총 n 번 만큼 실행

Array

Delete procedure in array



총 실행 수
a+n-a-1 = n-1

총 n-1번 만큼 실행

문제점
N개가 적으면 괜찮지만 숫자가 커질수록 10만,100만이 되면 하나를 넣거나 뺄때 그 전체를 다 실행해야한다

해결

Linked List

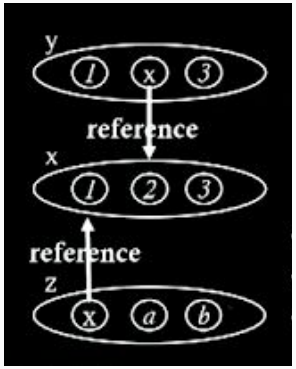
Array and List

Array
고유한 식별자와 그 식별자에 대응하는 데이터의 묶음
인덱스 번호를 이용해서 빠르게 접근을 할 수 있지만 추가나 삭제행위가 실행되면 모든 데이터가 움직여야해서 용이하지 않다
(주민등록번호 처럼 앞 사람이 죽는다고 내 주민등록번호가 변하거나 사라지지않음)

List
같은 값이 한 번 이상 존재할 수 있는 일련의 값이 모여있는 추상적 자료형
List는 pointer라는 개념이 있는데 하나의 메모리에는 pointer도 같이 존재하고 그 pointer는 다음 메모리의 위치를
가르키고 있다.추가나 삭제할 경우 필요한 메모리만 건들기 때문에 동작속도가 빠름

	Read	Write/Update/Delete
Array :	빠름	느림
List :	느림	빠름

Linked List

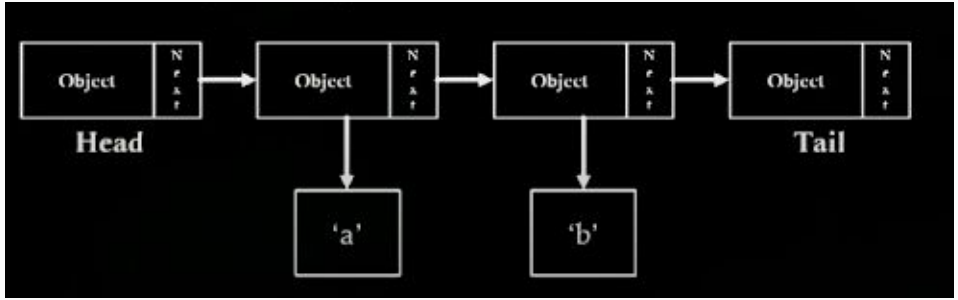


Reference 를 이해하고 있어야지 Linked List를 사용할 수 있다.

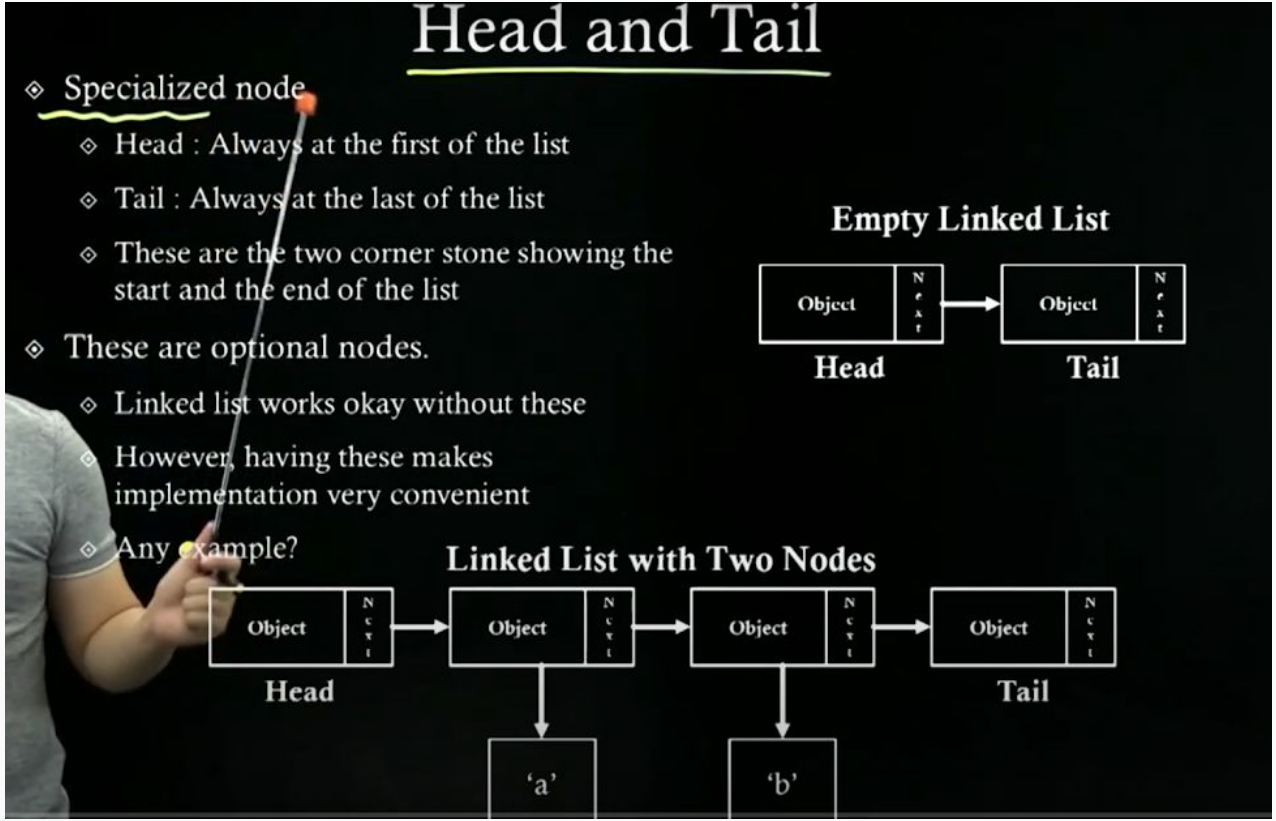
Singly Linked List

node:
두가지 Variable로 이루어져 있다.
1. next node
2. value

special node = head and tail
값은 없고 존재하기만 함



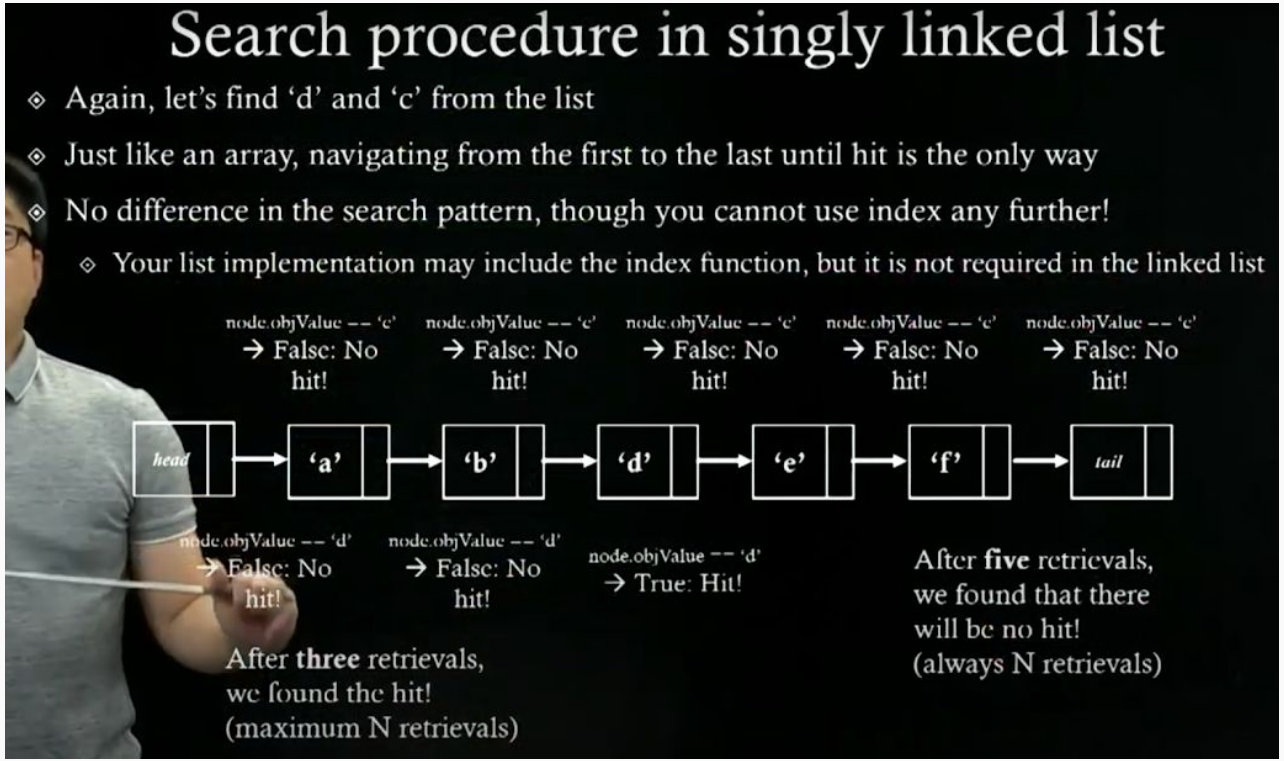
LinkedList



Head와 Tail의 Object부분은
비어있고 위치요소만
가지고있다

리스트의 시작과 끝만
알려주는 노드

Linked List



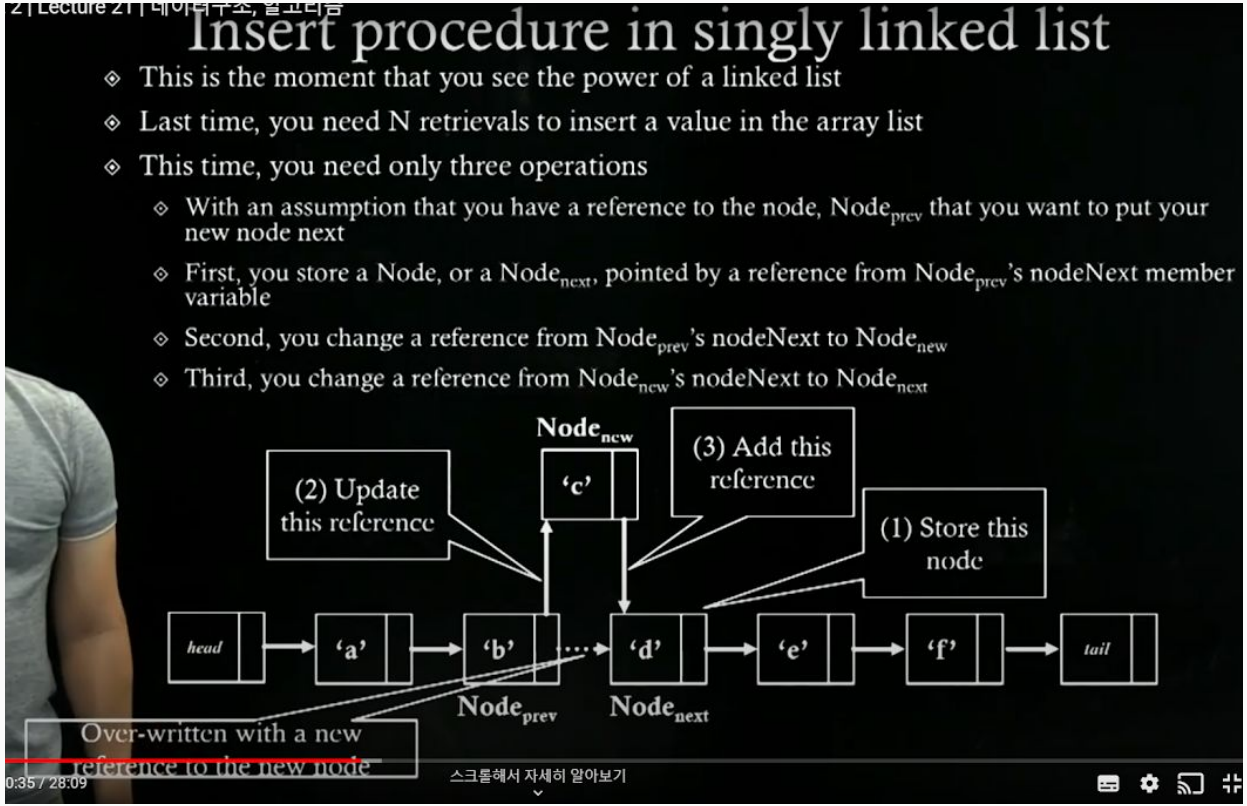
1.find head from list

2.next node

```
if next == tail
        break
elif next != tail
        find objValue
```

n번 검사를 해야 알 수 있음

Linked List

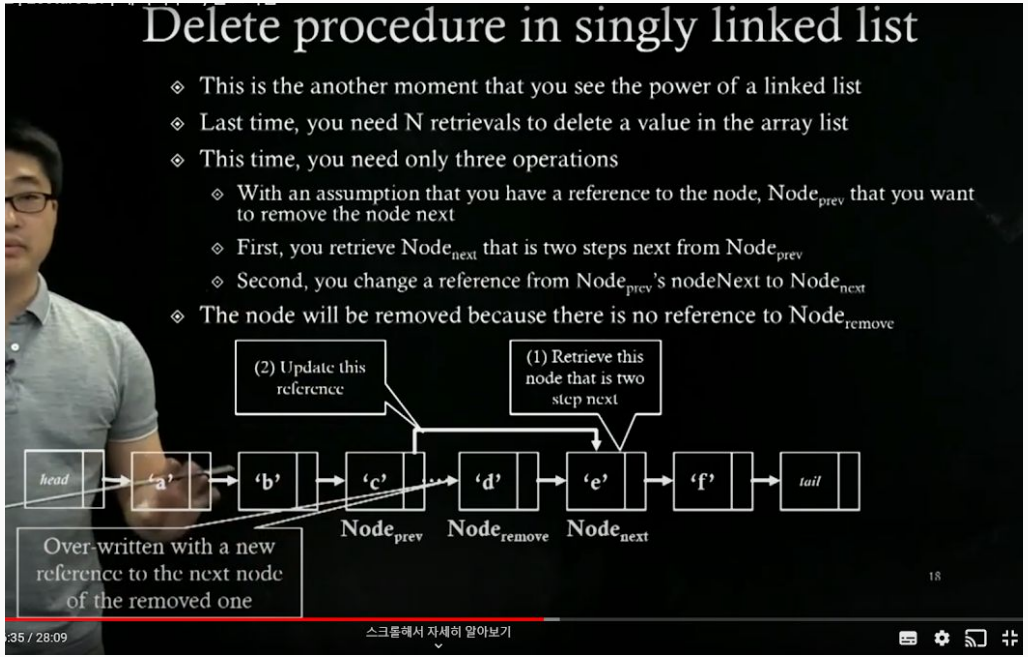


1.Node prev 의 next 를
끊어버리고 Node new를
가르키게 만든다

2.Node prev가 들고있던 next를
Node new 의 next에 집어넣는다

움직인건 3개의 노드뿐

Linked List



1.Node Remove = Node prev.next
2.Node next = Node prev.next.next

Node remove를 가르키는 노드가
없어지면서 사라진것처럼 보이게 되고
Garbage collector가 이런 메모리구조를
찾아서 메모리를 지움

사용된 노드는 3개의 노드 뿐

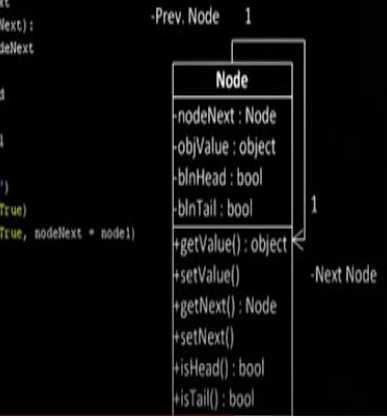
LinkedList Class

node클래스

LinkedList Class->

```
class Node:
    nodeNext = ''
    objValue = ''
    blnHead = False
    blnTail = False
    def __init__(self, objValue = '', nodeNext = '', blnHead = False, blnTail = False):
        self.nodeNext = nodeNext
        self.objValue = objValue
        self.blnHead = blnHead
        self.blnTail = blnTail
    def getValue(self):
        return self.objValue
    def setValue(self, objValue):
        self.objValue = objValue
    def getNext(self):
        return self.nodeNext
    def setNext(self, nodeNext):
        self.nodeNext = nodeNext
    def isHead(self):
        return self.blnHead
    def isTail(self):
        return self.blnTail

node1 = Node(objValue = 'a')
nodeTail = Node(blnTail = True)
nodeHead = Node(blnHead = True, nodeNext = node1)
```




```
class SinglyLinkedList:
    nodeHead = ''
    nodeTail = ''
    size = 0
    def __init__(self):
        self.nodeTail = Node(blnTail = True)
        self.nodeHead = Node(blnHead = True, nodeNext = self.nodeTail)

    def insertAt(self, objInsert, idxInsert):
        nodeNew = Node(objValue = objInsert)
        nodePrev = self.get(idxInsert - 1)
        nodeNext = nodePrev.getNext()
        nodePrev.setNext(nodeNew)
        nodeNew.setNext(nodeNext)
        self.size = self.size + 1

    def removeAt(self, idxRemove):
        nodePrev = self.get(idxRemove - 1)
        nodeRemove = nodePrev.getNext()
        nodeNext = nodeRemove.getNext()
        nodePrev.setNext(nodeNext)
        self.size = self.size - 1
        return nodeRemove.getValue()

    def get(self, idxRetrieve):
        nodeReturn = self.nodeHead
        for itr in range(idxRetrieve + 1):
            nodeReturn = nodeReturn.getNext()
        return nodeReturn

    def printStatus(self):
        nodeCurrent = self.nodeHead
        while nodeCurrent.getNext().isTail() == False:
            nodeCurrent = nodeCurrent.getNext()
            print nodeCurrent.getValue(),
        print

    def getSize(self):
        return self.size
```

Implementation of Singly linked list

Empty Linked List


```
list1 = SinglyLinkedList()
list1.insertAt('a', 0)
list1.insertAt('b', 1)
list1.insertAt('d', 2)
list1.insertAt('e', 3)
list1.insertAt('f', 4)
list1.printStatus()

list1.insertAt('c', 2)
list1.printStatus()

list1.removeAt(3)
list1.printStatus()
```

```
a b d e f
a b c d e f
a b c e f
```

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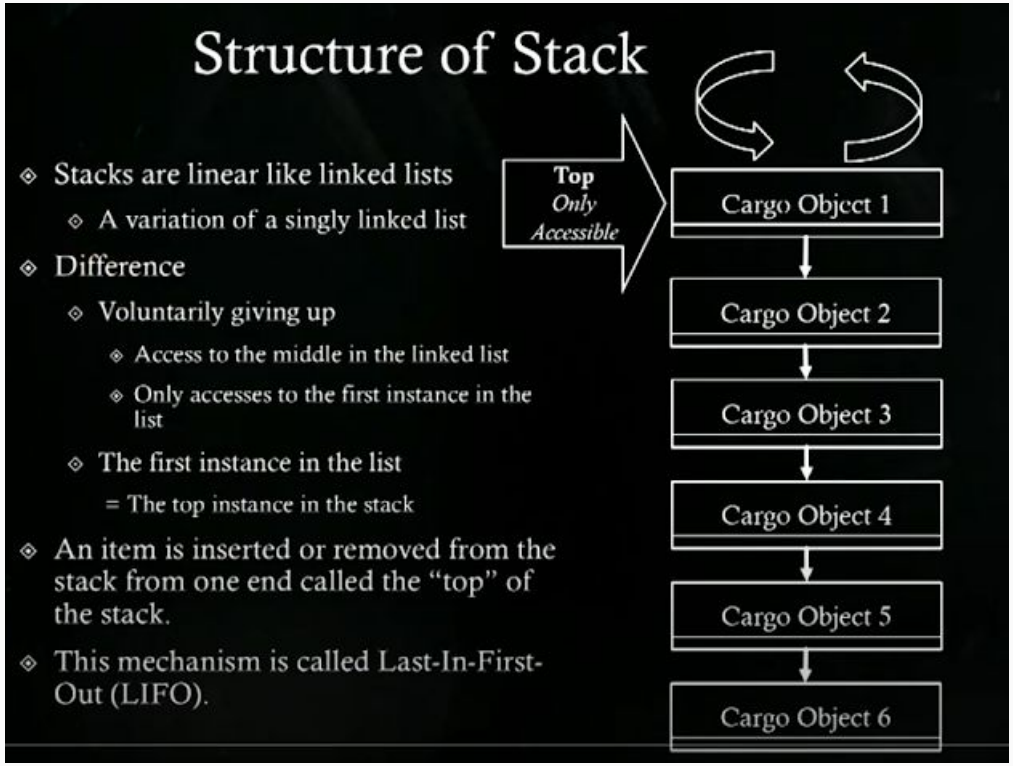
Scenario for Stack

- Back seat of a taxi
  - One way in and out
  - We are traveling from the source to our destinations
  - Who should seat first and last?
- A scenario for a taxi
  = A scenario for SCM
  - A cargo plane with one way in and out
  - How to organize the cargo loading to the plane?

Stack

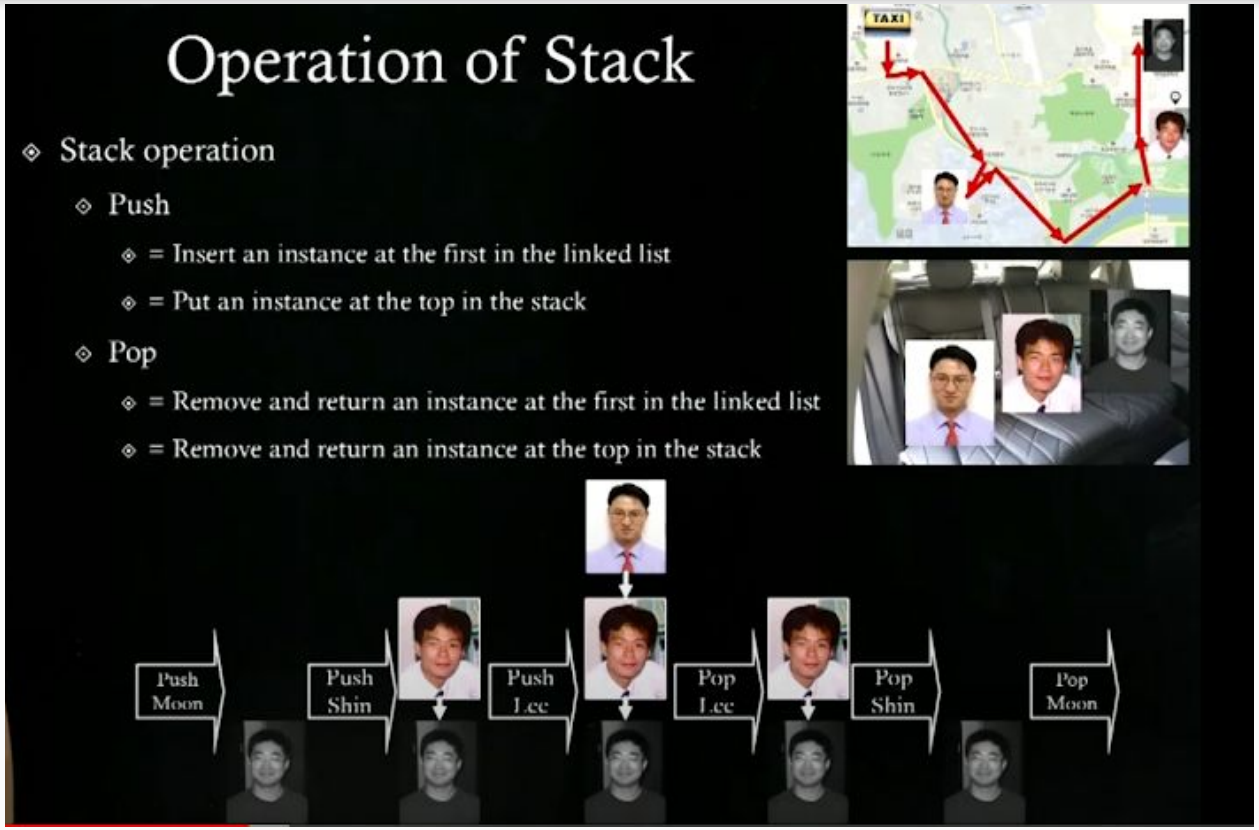


선형적이다

오직 첫 노드에 대해서만 관여함

LIFO
(Last in First out)

Stack

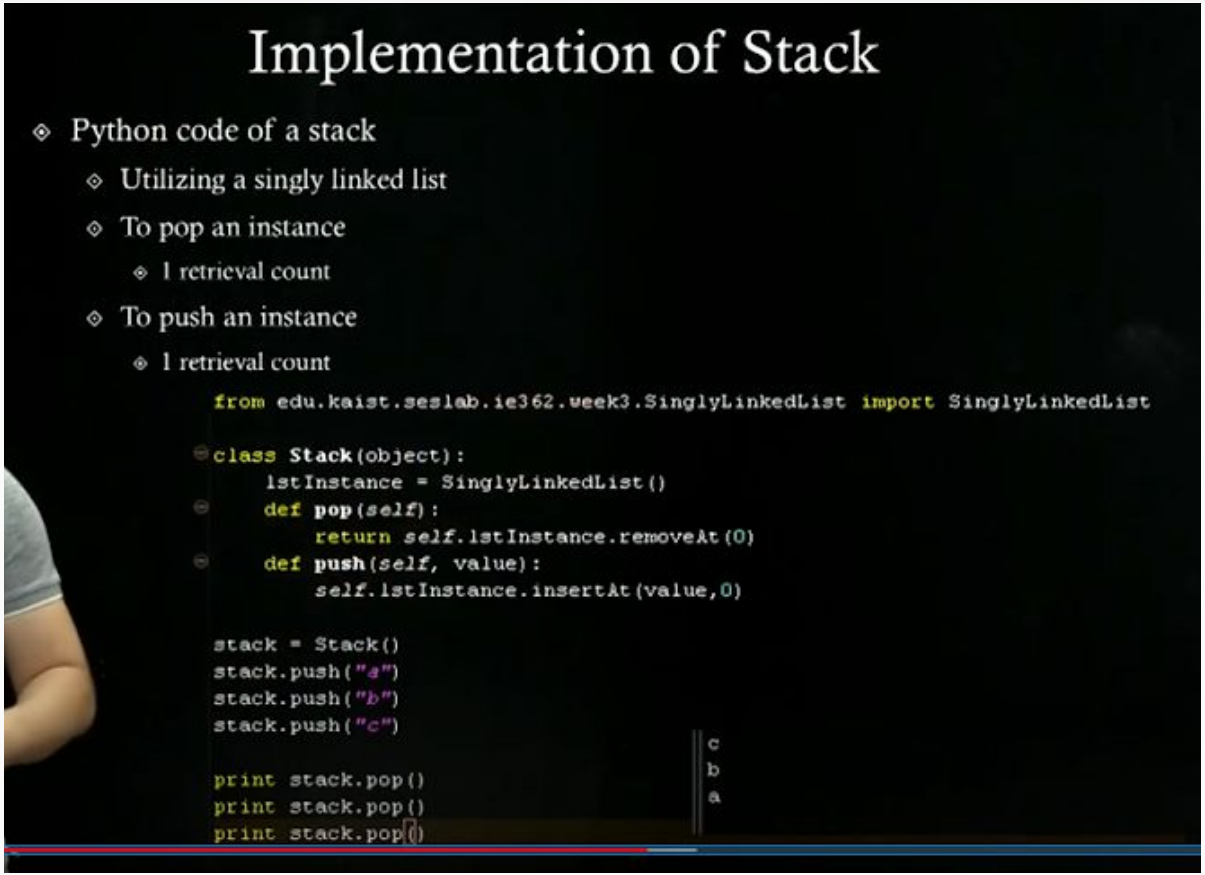


Top만 알 수 있다

Push
Top에 넣기

Pop
Top 빼기

Stack Class



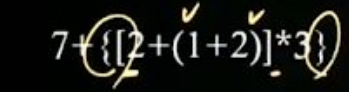
SinglyLinkedList를 활용함

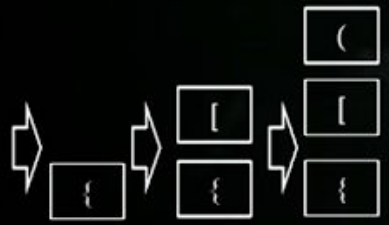
0번째만 건드림

Example

Example: Balancing Symbols

- Balancing symbols?
  - [2+(1+2)]-3 → Symbols are balanced
  - [2+(1+2]-3 → Symbols are not balanced
  - Then, just counting opening and closing symbols?
    - What if? [2+(1]+2)-3
- Algorithm for the balanced symbol checking
  - Make an empty stack
  - read symbols until end of formula
    - if the symbol is an opening symbol push it onto the stack
    - if it is a closing symbol do the following
      - If the stack is empty report an error
      - Otherwise pop the stack.
        - If the symbol popped does not match the closing symbol report an error
  - At the end of the of formula if the stack is not empty report an error





Queue

Scenario for Queue

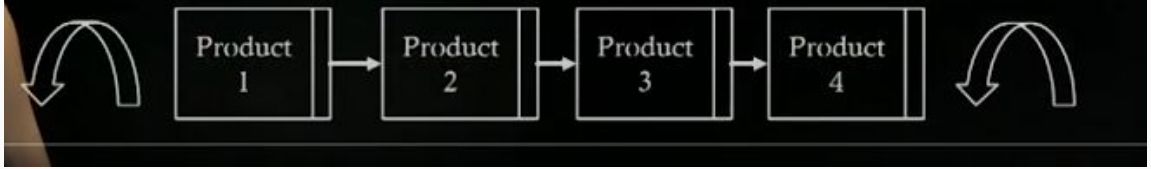
- Line at an airport
  - A way for going in
    - At the end of the line
  - Another way for going out
    - At the first of the line
  - No one gets in the middle of the line
- A scenario of a line at the airport = A scenario of a production line at a factory
  - The first product out is the first product in
  - How to track the production line?

FIFO
(First In First Out)
터널

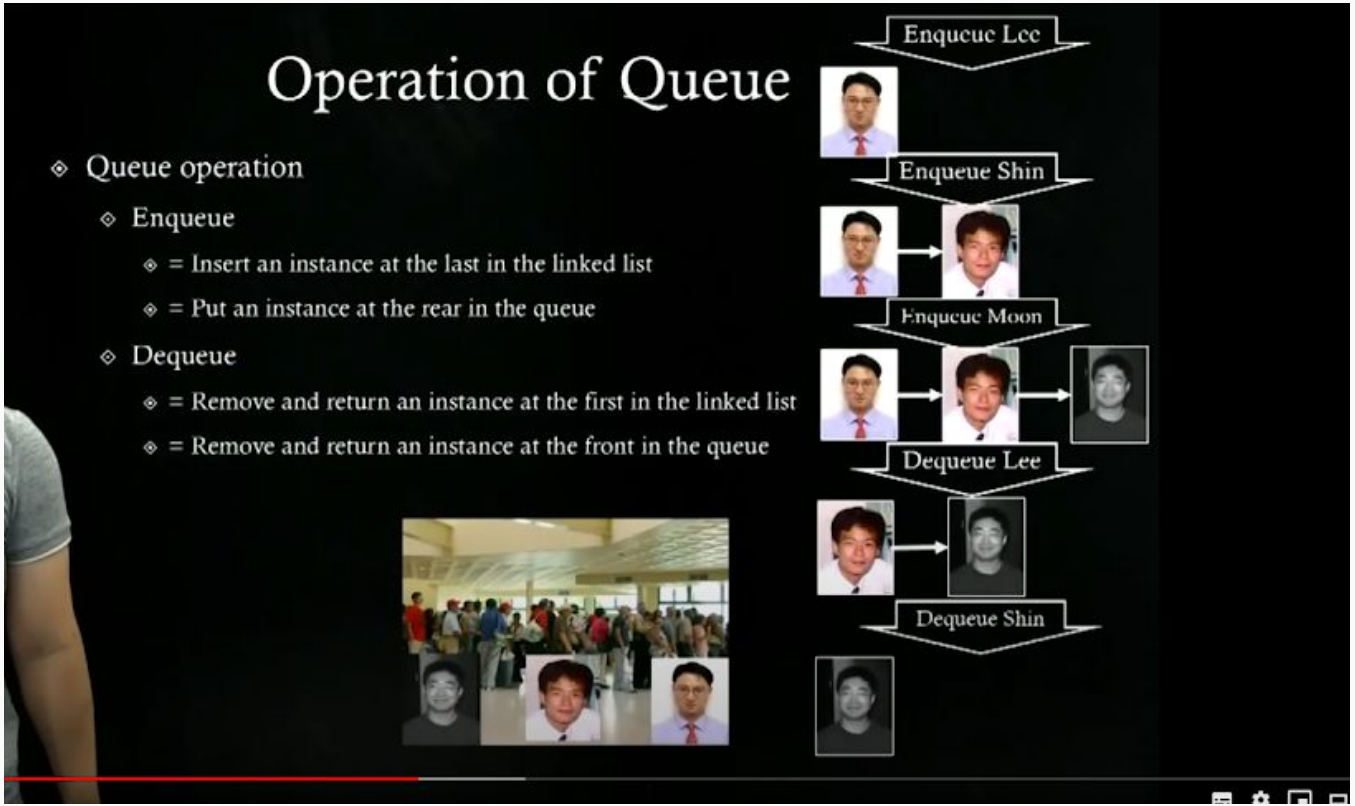
Queue Structure

Structure of Queue

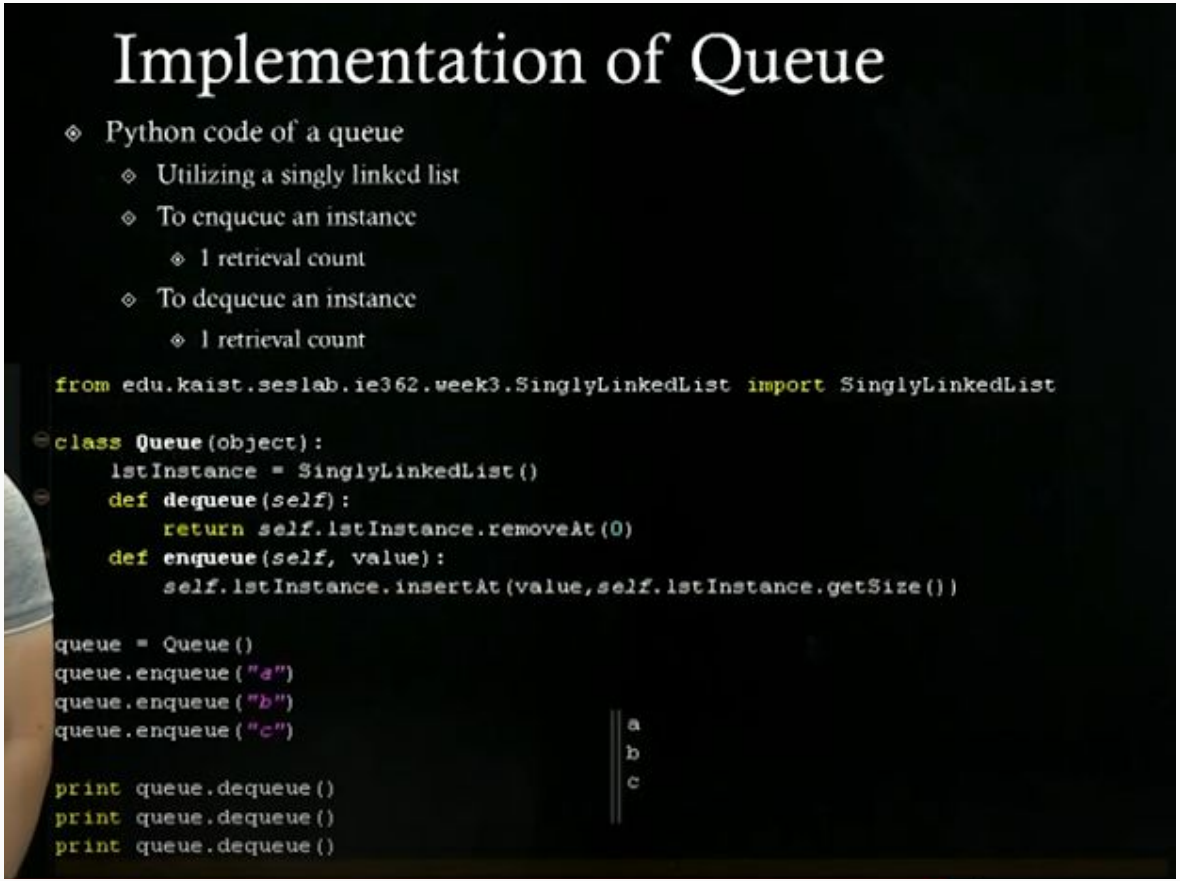
- Queues are linear like linked lists
  - A variation of a singly linked list
- Difference
  - Voluntarily giving up
    - Access to the middle in the linked list == Same to the stacks
    - Only accesses to the first and the last instances in the list
  - The first instance in the list
    = The front instance in the queue
  - The last instance in the list
    = The rear instance in the queue
- An item is inserted at the last
- An item is removed at the front
- This mechanism is called Fast-In-First-Out (FIFO)



Operation of Queue



Queue Class


Implementation of Queue
Python code of a queue
Utilizing a singly linked list
To enqueue an instance
1 retrieval count
To dequeue an instance
1 retrieval count
from edu.kaist.seslab.ie362.week3.SinglyLinkedList import SinglyLinkedList
class Queue(object):
lstInstance = SinglyLinkedList()
def dequeue(self):
return self.lstInstance.removeAt(0)
def enqueue(self, value):
self.lstInstance.insertAt(value,self.lstInstance.getSize())
queue = Queue()
queue.enqueue("a")
queue.enqueue("b")
queue.enqueue("c")
print queue.dequeue()
print queue.dequeue()
print queue.dequeue()
a
b
c