CSC148-Section:L0301/L0401 Week#4-Wednesday

Instructed by

AbdulAziz Al-Helali

a.alhelali@mail.utoronto.ca

Office hours: Wednesday 11-1, BA2230.

Slides adapted from Professor Danny Heap course material winter17

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Outline

- Linked Lists
  - Implement methods in LinkedList – Cont..
    - delete_front
    - pop_front
    - delete_back
  - Rebuild Stack/Queue using LinkedList
  - Test Performance
    - Stack/Queues using **Python list** vs Stack/Queues using **LinkedList**

delete_front

```
def delete_front(self) -> None:
    """
    Delete LinkedListNode self.front from self.
    Assume self.front is not None
    >>> lnk = LinkedList()
    >>> lnk.prepend(0)
    >>> lnk.prepend(1)
    >>> lnk.prepend(2)
    >>> lnk.delete_front()
    >>> str(lnk.front)
    '1 ->0 ->|'
    >>> lnk.size
    2
    >>> lnk.delete_front()
    >>> lnk.delete_front()
    >>> str(lnk.front)
    'None'
    """
```

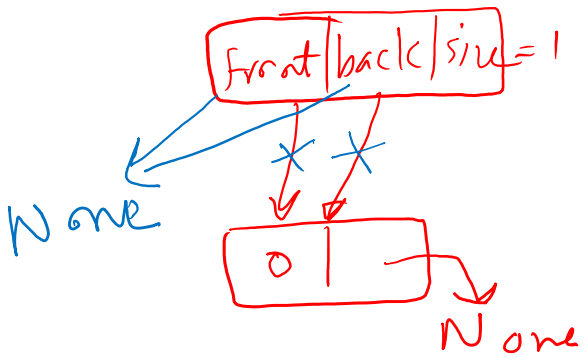
`delete_front`

- Two cases:
  - The list has only one node
  - The list has more than one node

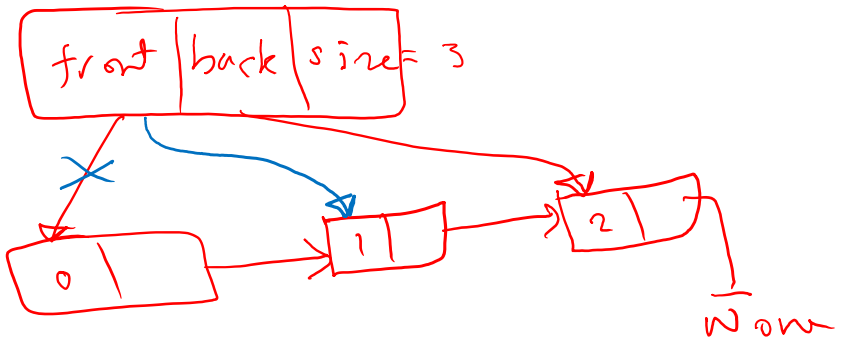
delete_front

- Two cases:
  - The list has only one node
  - The list has more than one node

① if size == 1



② else:



delete_front

```
def delete_front(self) -> None:
    """
    """
    if self.size == 1 :
        self.front=self.back=None
    else:
        new_front = self.front.next_
        self.front = new_front
    self.size -= 1
```

pop_front

We need this method to implement stack and queues using LinkedList
We can not use delete_front because it returns nothing

```
def pop_front(self):
    """
    Remove self.front and return its value. Assume
    self.size >= 1

    @param LinkedList self: this LinkedList
    @rtype: object

    >>> lnk = LinkedList()
    >>> lnk.append(0)
    >>> lnk.append(1)
    >>> lnk.pop_front()
    0
    """
```

pop_front

```
def pop_front(self):
    """
    """
    first = self.front.value
    self.delete_front()
    return first
```

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delete_back

```
def delete_back(self) -> None:
    """
    Delete LinkedListNode self.back from self.
    Assume self.back is not None
    >>> lnk = LinkedList()
    >>> lnk.prepend(0)
    >>> lnk.prepend(1)
    >>> lnk.prepend(2)
    >>> lnk.delete_back()
    >>> str(lnk.back)
    '1 ->|'
    >>> lnk.size
    2
    >>> lnk.delete_back()
    >>> lnk.delete_back()
    >>> str(lnk.back)
    'None'
    """
```

delete_back

- We need to find the second last node. Walk two references along the list.

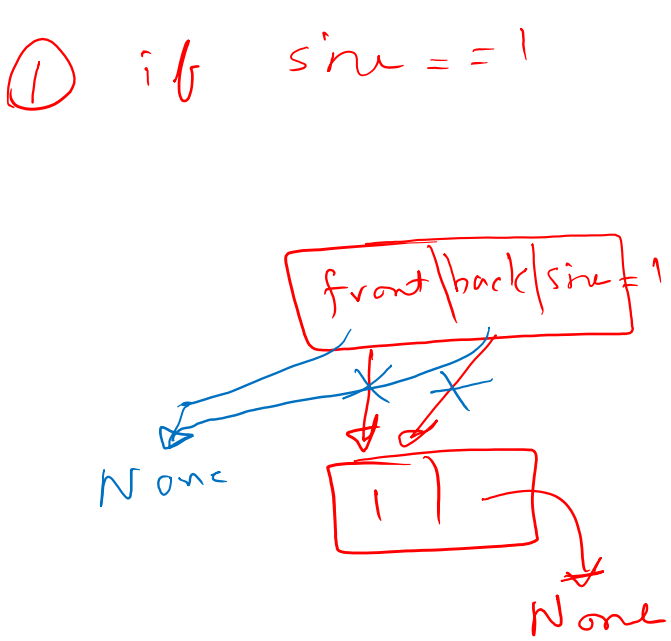
```
prev_node, cur_node = None, lnk.front
# walk along until cur_node is lnk.back
while <some condition>:
    prev_node = cur_node
    cur_node = cur_node.nxt
```

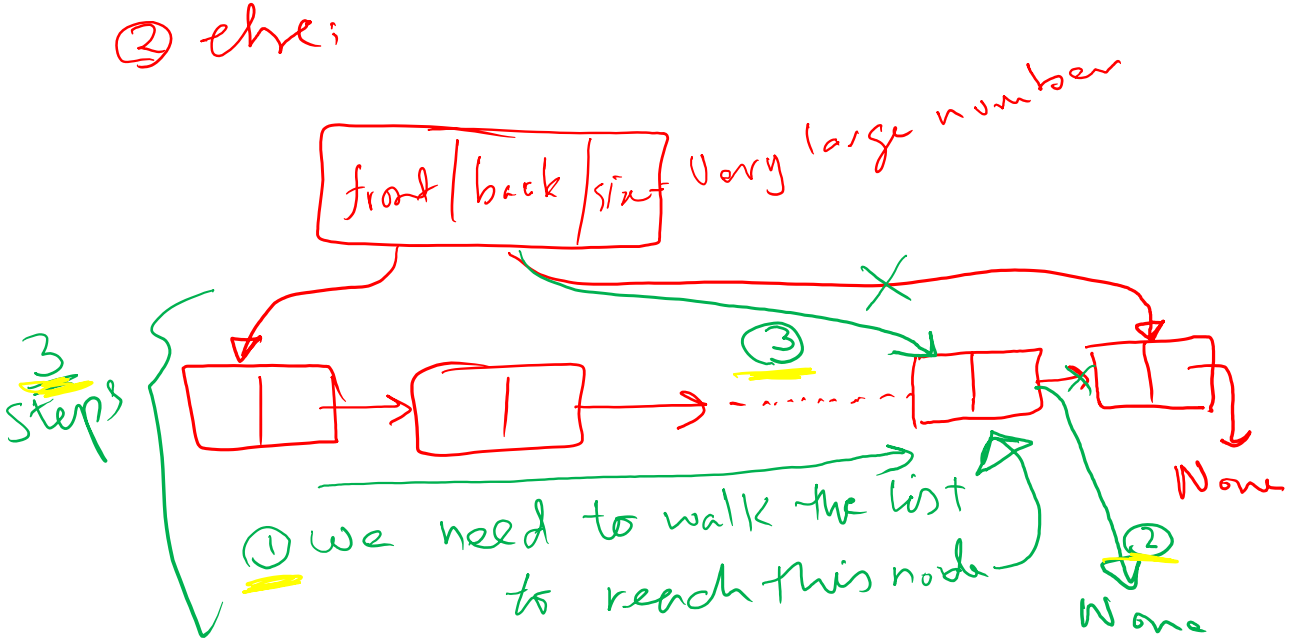
`delete_back`

- Two cases:
  - The list has only one node
  - The list has more than one node

delete_back

- Two cases:
  - The list has only one node
  - The list has more than one node





delete_back

```
def delete_back(self) -> None:
    """
    """
    if self.size==1:
        self.front=self.back=None
    else:
        prev_node = None
        cur_node = self.front
        while cur_node != self.back:
            prev_node = cur_node
            cur_node = cur_node.next_
        self.back = prev_node
        self.back.next_ = None
    self.size -= 1
```

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Rebuild Stack/Queue using LinkedList

- something linked lists do better than Python lists?

  Python list:

  L=[1,2,3,……,100]

Is **Remove** from end a problem?

Is **add** to end a problem?

1	2	3	…….	99	100

Is **Remove** from beginning a problem?

Is **add** to beginning a problem?

Will this impact the performance of a Queue or Stack that uses python list?

Rebuild Stack/Queue using LinkedList

- something linked lists do better than lists?
  - Adding to the back and removing from the front

- list-based Queue has a problem: adding or removing will be slow.

Rebuild Stack/Queue using LinkedList

- Do the following changes:
  - **Stack**
    - self._storage = LinkedList()
    - add
      - self._storage.prepend(obj) # adding to the front
    - Remove
      - return self ._storage.pop_front() # removing to the front
  - Queue
    - self._storage = LinkedList()
    - add
      - self._storage.append(obj)) # adding to the back
    - Remove
      - return self ._storage.pop_front() # removing from to the back

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Test Performance

```
def container_cycle(c: Container, r: int) -> str:
    """
    Add/remove c r times.
    c - Container to add/remove
    r - number of times to add/remove
    """
#     start = time()
    for i in range(r):
        c.add(i)
    start = time()
    for i in range(r):
        # repeatedly add and remove
        c.remove()
        c.add(i)
    print("{} add/remove in {} seconds".format(r, time() - start))
```

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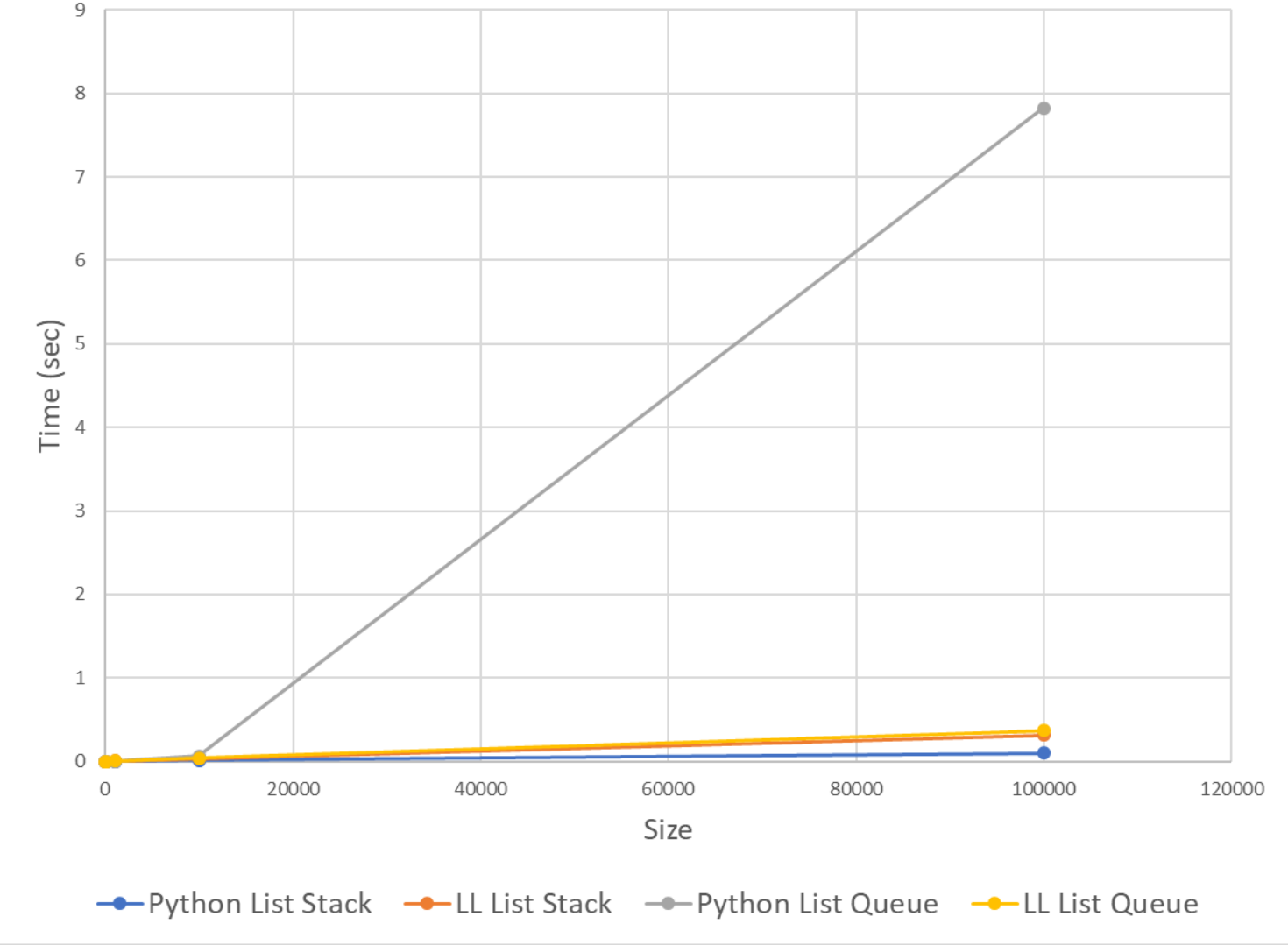
Test Performance



Where Can I find the code presented in class

- You can find the full code in the course website under section **MWF2 (L0301) and MWF3 (L0401)**
- with the following file names:
  - linked_list_Wednesday.py
  - stack_as_list.py
  - stack_as_ll.py
  - queue_as_list.py
  - queue_as_ll.py
  - container.py
  - testing_performance.py
- Download them Try different things with them and practice
  - Do not be afraid of doing mistakes