test average: ~75% (pretty good). Re-mark requests: on MarkUs
handful (~3 this section) not graded yet.

CSC148 winter 2017

stack application, linked lists, iteration, mutation — week 6

Danny Heap
heap@cs.toronto.edu / BA4270 (behind elevators)
http://www.cdf.toronto.edu/~heap/148/W17/
416-978-5899

February 15, 2017

Outline

balanced parentheses

linked lists

mutation

parenthesization

In some situations it is important that opening and closing parentheses, brackets, braces match.

'(1 + [7 - {8 / 3}])' — good

what are the rules?

'(1 + [7 - {8 / 3]})' — bad

Remember, the computer only "sees" one character at a time.

define balanced parentheses:

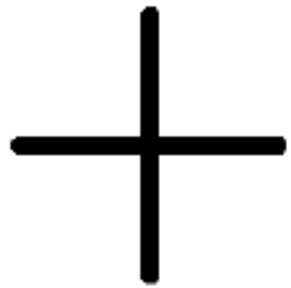
- a string with no parentheses is balanced
- a string that begins with a left parenthesis "(", ends with a right parenthesis ")", and in between has balanced parentheses is balanced. Same for brackets '"[...]" and braces "..."
- the concatenation of two strings with balanced parentheses is also balanced

stack: (

stack: (

1

stack: (



stack: [
(

stack: [
(

7

stack: [
(

stack: {
[
(

stack: {
[
(

stack: {
[
(

stack: {
[
(

3

stack: [
(

stack: (

stack:

(is not [--- oooops!

why linked lists?

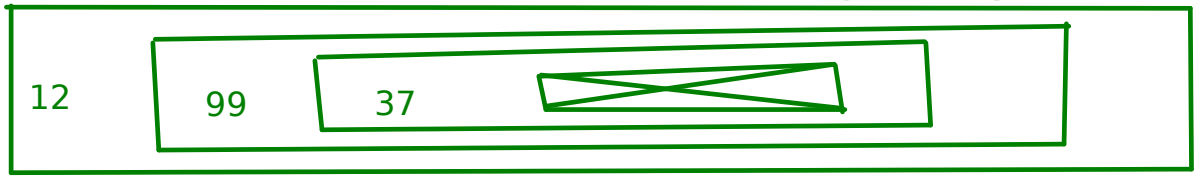
regular Python lists are flexible and useful, but overkill in some situations — they allocate large blocks of contiguous memory, which becomes increasingly difficult as memory is in use.

linked list nodes reserve just enough memory for the object value they want to refer to, a reference to it, and a reference to the next node in the list.

linked lists, two concepts

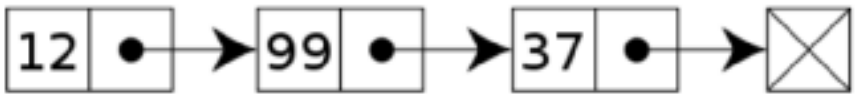
There are two useful, but different, ways of thinking of linked list nodes

1. as lists made up of an item (value) and a sub-list (rest)



2. as objects (nodes) with a value and a reference to other similar objects

This is our point-of-view (for now)



For now, will take the second point-of-view, and design a separate "wrapper" to represent a linked list as a whole.

a node class

```
class LinkedListNode:
    """
    Node to be used in linked list

    === Attributes ===
    @param LinkedListNode next_: successor to this LinkedListNode
    @param object value: data this LinkedListNode represents
    """

    def __init__(self, value, next_=None):
        """
        Create LinkedListNode self with data value and successor next_.

        @param LinkedListNode self: this LinkedListNode
        @param object value: data of this linked list node
        @param LinkedListNode|None next_: successor to self
        @rtype: None
        """
        self.value, self.next_ = value, next_
```

a wrapper class for list

The list class keeps track of information about the entire list — such as its front, back, and size.

```
class LinkedList:
    """
    Collection of LinkedListNodes

    === Attributes ==
    @param: LinkedListNode front: first node of this LinkedList
    @param LinkedListNode back: last node of this LinkedList
    @param int size: number of nodes in this LinkedList
                        a non-negative integer
    """
    def __init__(self):
        """
        Create an empty linked list.

        @param LinkedList self: this LinkedList
        @rtype: None
        """
        self.front, self.back, self.size = None, None, 0
```

division of labour

Some of the work of special methods is done by the nodes:

5 -> 7 -> 11 -> 13 ->|

- `__str__`

- `__eq__`

How do I decide that two LLNodes are __eq__

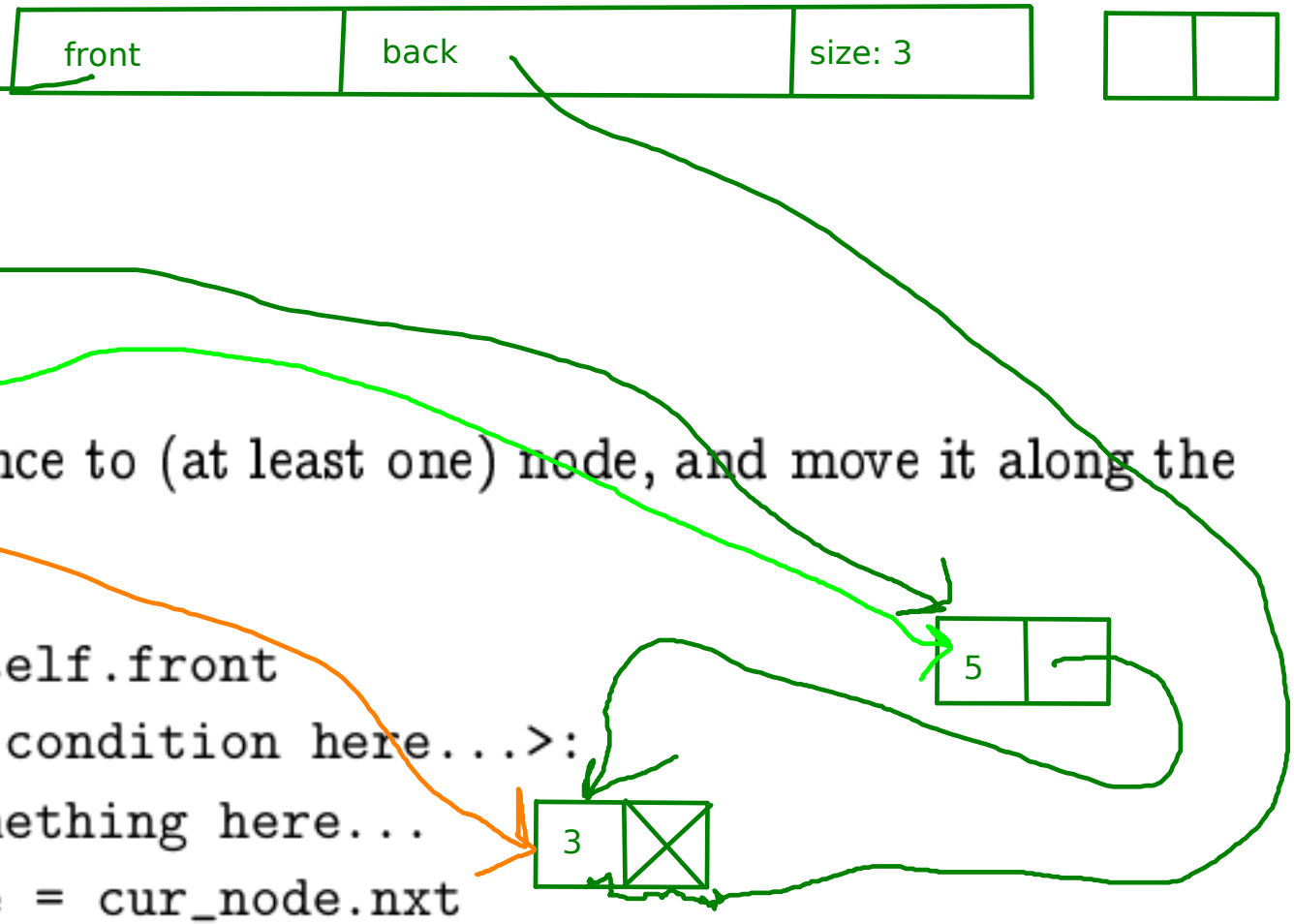
entire chains, until None, are equivalent (use this approach)

just the values match

same id

Once these are done for nodes, it's easy to do them for the entire list.

walking a list

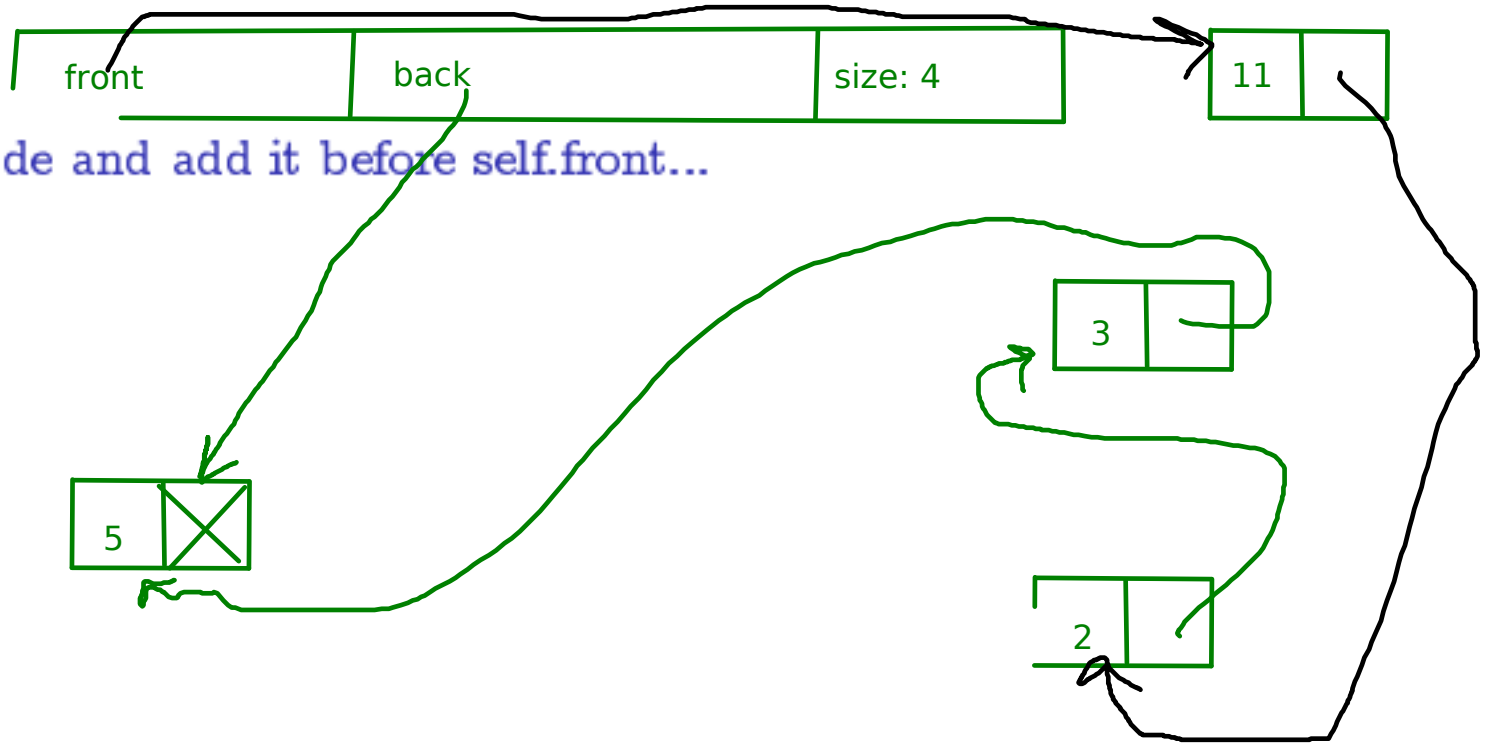


Make a reference to (at least one) node, and move it along the list:

```
cur_node = self.front
while <some condition here...>:
    # do something here...
    cur_node = cur_node.nxt
```

prepend

create a new node and add it before self.front...



__contains__

Check (possibly) every node

```
cur_node = self.front
while <some condition here...>:
    # do something here...
    cur_node = cur_node.nxt
```

__getitem__

idea: start at front
count index steps along list
return the value

what could possibly go wrong?

index < -size or index >= size
ok: -size <= index < size

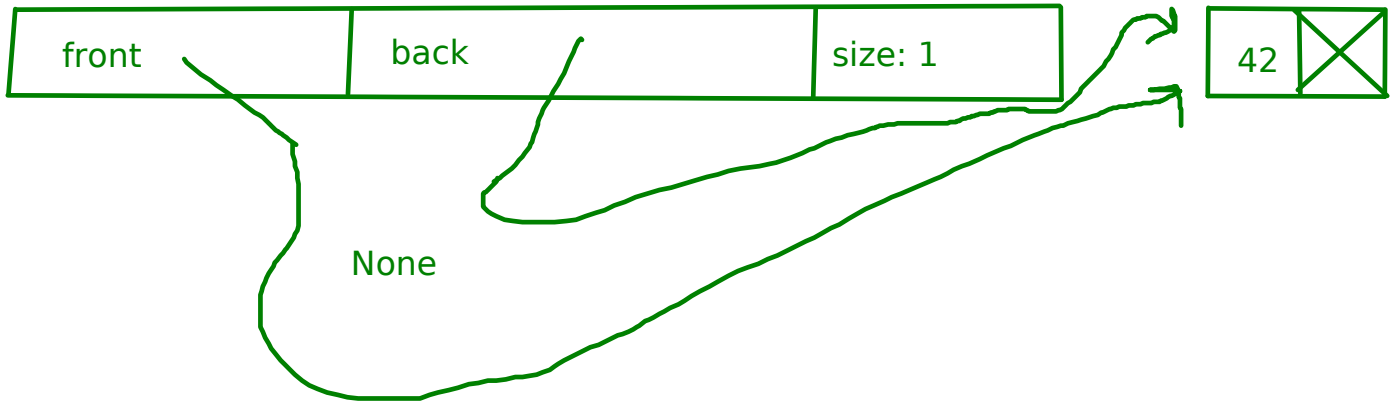
Should enable things like

```
>>> print(lnk[0])
5
```

... or even

```
>>> print(lnk[0:3])
5 -> 4 -> 3 ->|
```

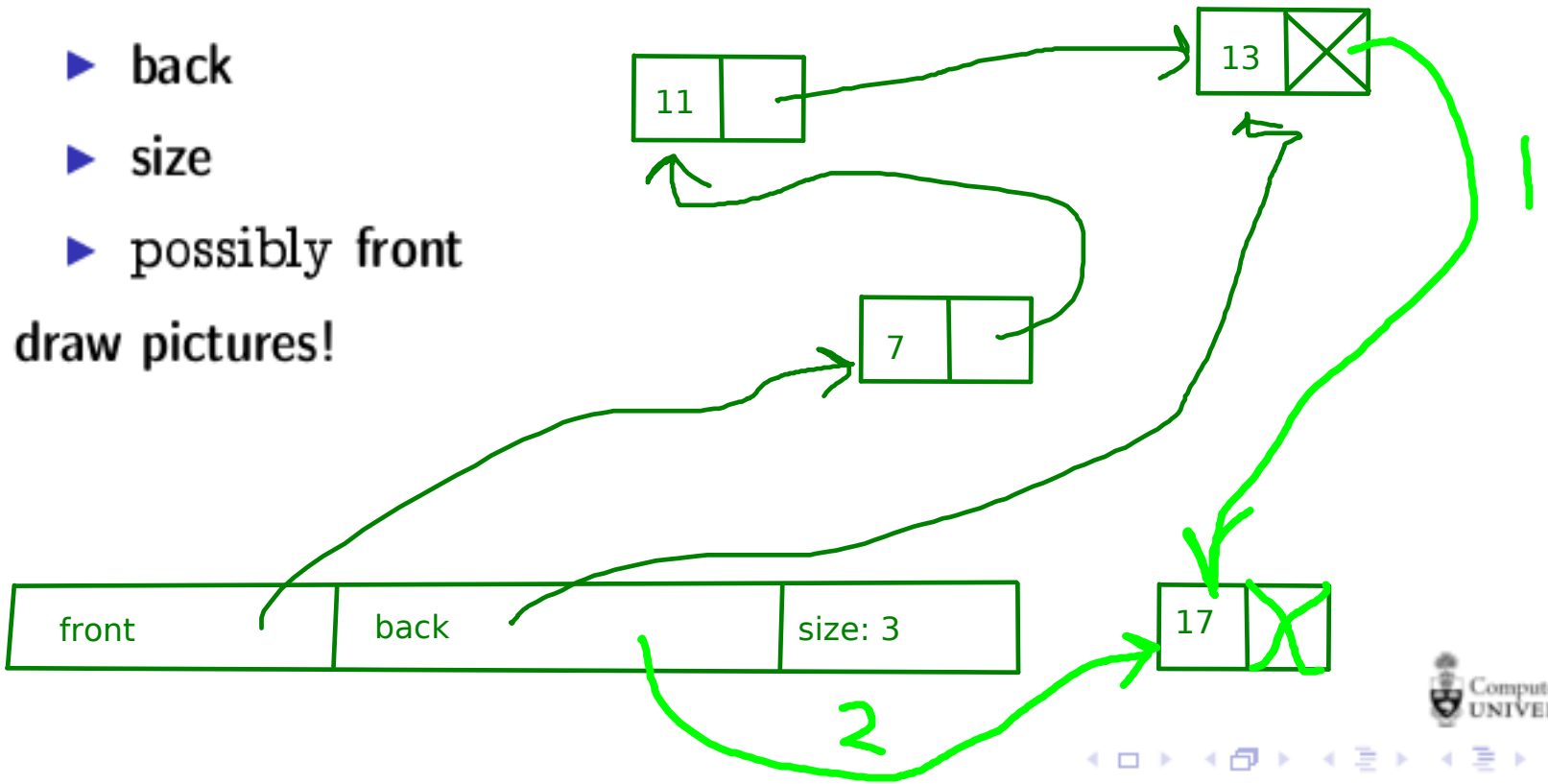
append



We'll need to change...

- last node
- former last node
- **back**
- **size**
- possibly **front**

draw pictures!



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
```

notes...