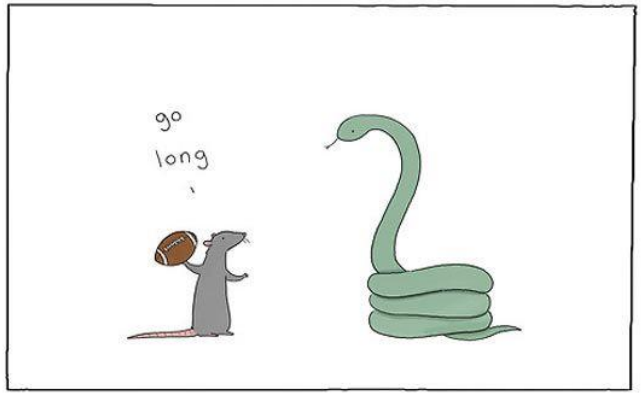
CSc 110, Autumn 2016

Lecture 19: lists as Parameters

Adapted from slides by Marty Stepp and Stuart Reges



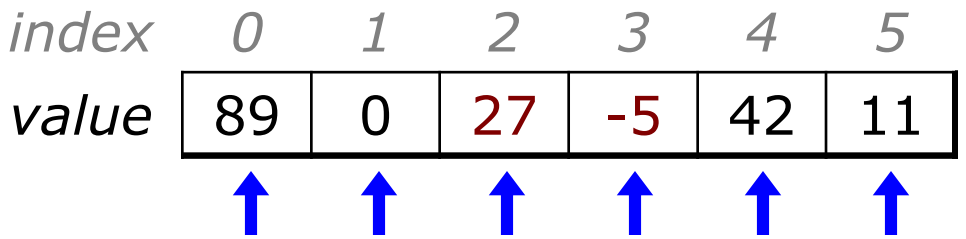
lizclimo.tumblr.com

List reversal question

- Write code that reverses the elements of a list.
  - For example, if the array initially stores:
    `[11, 42, -5, 27, 0, 89]`
  - Then after your reversal code, it should store:
    `[89, 0, 27, -5, 42, 11]`
    - The code should work for a list of any size.
    - Hint: think about swapping various elements...

Algorithm idea

- Swap pairs of elements from the edges; work inwards:



List reverse question 2

- Turn your list reversal code into a `reverse` function.
  - Accept the list of integers to reverse as a parameter.

```
numbers = [11, 42, -5, 27, 0, 89]
reverse(numbers)
```

  - How do we write functions that accept lists as parameters?
  - Will we need to return the new list contents after reversal?

    …

Reference semantics

A `swap` function?

- Does the following `swap` function work? Why or why not?

```
def main():
    a = 7
    b = 35

    # swap a with b?
    swap(a, b)

    print(str(a) + " " + str(b))

def swap(a, b):
    temp = a
    a = b
    b = temp
```

Value semantics

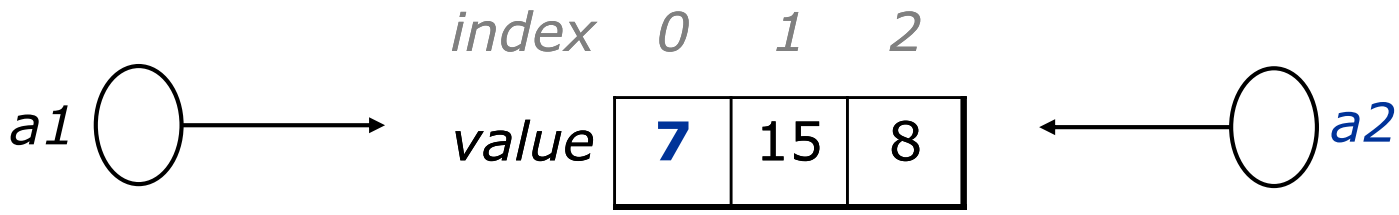
- **value semantics**: Behavior where values are copied when changed.
  - ints, floats, strings and booleans in Python use value semantics.
  - When one variable is assigned to another and then that variable is changed, its value is copied.
  - Modifying the value of one variable does not affect others.

```
x = 5
y = x          # x = 5, y = 5
y = 17         # x = 5, y = 17
x = 8          # x = 8, y = 17
```

Reference semantics

- **reference semantics**: Behavior where variables actually store the address of an object in memory.
  - When one variable is assigned to another, the object is *not* copied; both variables refer to the *same object*.
  - Modifying the value of one variable *will* affect others.

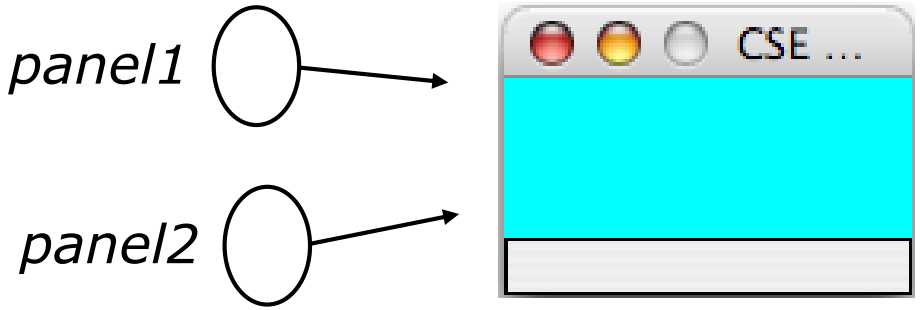
```
a1 = [4, 15, 8]
a2 = a1                 # refer to same list as a1
a2[0] = 7
print(a1)               # [7, 15, 8]
```



References and objects

- Lists and objects use reference semantics. Why?
  - *efficiency.* Copying large objects slows down a program.
  - *sharing.* It's useful to share an object's data among methods.

```
panel1 = DrawingPanel(80, 50)
panel2 = panel1    # same window
panel2.canvas.create_rectangle(0, 0, 80, 50, fill="cyan")
```

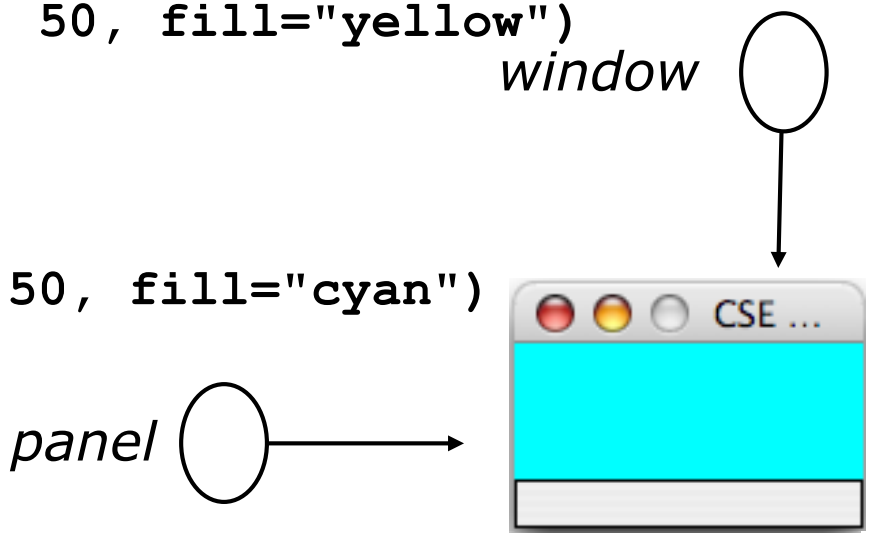


Objects as parameters

- When an object is passed as a parameter, the object is *not* copied. The parameter refers to the same object.
  - If the parameter is modified, it *will* affect the original object.

```
def main():
    window = DrawingPanel(80, 50)
    window.canvas.create_rectangle(0, 0, 80, 50, fill="yellow")
    example(window)

def example(panel):
    panel.canvas.create_rectangle(0, 0, 80, 50, fill="cyan")
  ...
```



Lists pass by reference

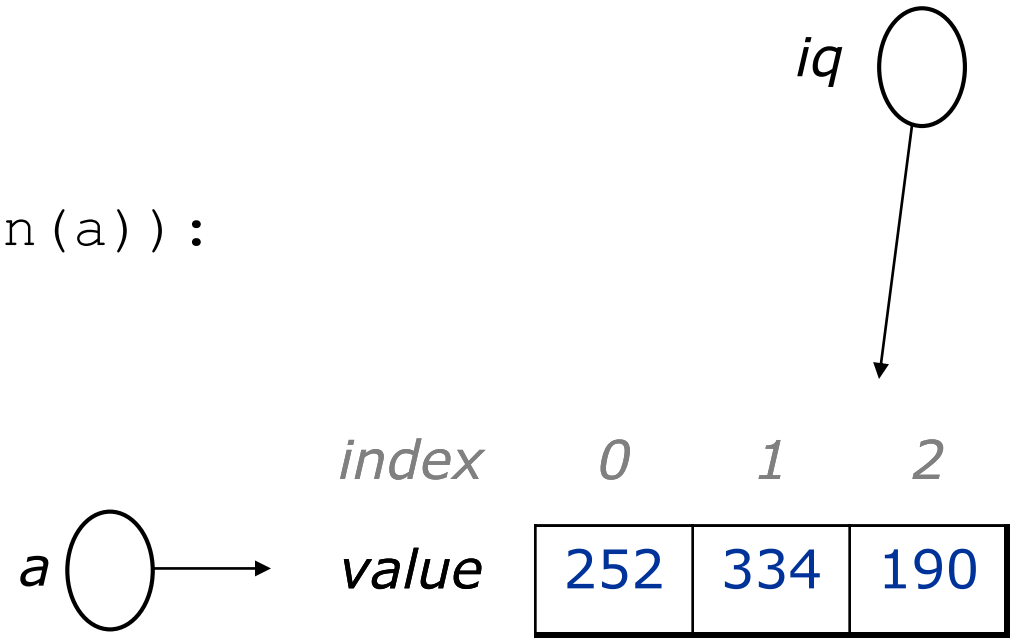
- Lists are passed as parameters by *reference.*
  - Changes made in the function are also seen by the caller.

```
def main():
    iq = [126, 167, 95]
    increase(iq)
    print(iq)

def increase(a):
    for i in range(0, len(a)):
        a[i] = a[i] * 2
```

  - Output:

```
[252, 334, 190]
```



List reverse question 2

- Turn your list reversal code into a `reverse` function.
  - Accept the list of integers to reverse as a parameter.

```
numbers = [11, 42, -5, 27, 0, 89]
reverse(numbers)
```

- Solution:

```
def reverse(numbers):
    for i in range(0, len(numbers) // 2):
        temp = numbers[i]
        numbers[i] = numbers[len(numbers) - 1 - i]
        numbers[len(numbers) - 1 - i] = temp
```

List parameter questions

- Write a function `swap` that accepts a list of integers and two indexes and swaps the elements at those indexes.

```
a1 = [12, 34, 56]
swap(a1, 1, 2)
print(a1)        # [12, 56, 34]
```

- Write a function `swap_all` that accepts two lists of integers as parameters and swaps their entire contents.
  - Assume that the two lists are the same length.

```
a1 = [12, 34, 56]
a2 = [20, 50, 80]
swap_all(a1, a2)
print(a1)  # [20, 50, 80]
print(a2)  # [12, 34, 56]
```

List parameter answers

```
# Swaps the values at the given two indexes.
def swap(a, i, j):
    temp = a[i]
    a[i] = a[j]
    a[j] = temp


# Swaps the entire contents of a1 with those of a2.
def swap_all(a1, a2):
    for i in range(0, len(a1)):
        temp = a1[i]
        a1[i] = a2[i]
        a2[i] = temp
```

List return question

- Write a function `merge` that accepts two lists of integers and returns a new list containing all elements of the first list followed by all elements of the second.

```
a1 = [12, 34, 56]
a2 = [7, 8, 9, 10]

a3 = merge(a1, a2)
print(a3)
# [12, 34, 56, 7, 8, 9, 10]
```

- Write a function `merge3` that merges 3 lists similarly.

```
a1 = {12, 34, 56]
a2 = {7, 8, 9, 10]
a3 = {444, 222, -1]

a4 = merge3(a1, a2, a3)
print(a4)
# [12, 34, 56, 7, 8, 9, 10, 444, 222, -1]
```

List return answer 1

```
# Returns a new list containing all elements of a1
# followed by all elements of a2.
def merge(a1, a2):
    result = [0] * (len(a1) + len(a2))

    for i in range(0, len(a1)):
        result[i] = a1[i]
    for i in range(0, len(a2)):
        result[len(a1) + i] = a2[i]

    return result
```

List return answer 2

```
# Returns a new list containing all elements of a1,a2,a3.
def merge3(a1, a2, a3):
    a4 = [0] * (len(a1) + len(a2) + len(a3)

    for i in range(0, len(a1)):
        a4[i] = a1[i]
    for i in range(0, len(a2)):
        a4[len(a1) + i] = a2[i]
    for i in range(0, len(a3)):
        a4[len(a1) + len(a2) + i] = a3[i]

    return a4

# Shorter version that calls merge.
def merge3(a1, a2, a3):
    return merge(merge(a1, a2), a3)
```