Lecture 5

Defining Functions

Announcements for this Lecture

Last Call

- Quiz: About the Course
- Take it by tomorrow
- Also remember the survey

Readings

- Sections 3.5 – 3.13 today
- Also 6.1-6.4
- See online readings for Tues

Install Party:

7pm Sunday

ACCEL Lab

First Assignment Posted This Weekend

- Due **Monday, September 17**
  - Submit earlier so we can start **iterative feedback process**
- Work alone or with **one partner**
  - Partners "group themselves" on the CMS
  - Only one person submits the files.
  - Partners must do the work together, sit next to each other, with each taking turns "driving" (writing the code)
- **Academic Integrity**
  - Never look at someone's code or show yours to someone else
  - Never possess someone else's code (except your partner)

One-on-One Sessions

- Starting Tomorrow: 1/2-hour one-on-one sessions
  - Bring computer and work with instructor, TA or consultant
  - Hands, dedicated help with Lab 2 and/or Lab 3
  - To prepare for assignment, but **no help assignment itself**
- **Limited availability: we cannot get to everyone**
  - **Students with experience or confidence should hold back**
- Sign up online in CMS: first come, first served
  - Choose assignment One-on-One
  - Pick a time that works for you; will add slots as possible
  - Can sign up starting at 1pm **TODAY**

Special Module for Assignment: urllib2

- urllib2 has a function called urlopen(url)
  - Single argument: string with a url
  - **Example**: urllib2.urlopen('http://www.cornell.edu')
  - Returns an **object**: a webpage!
    (But type() will identify it as an instance)
  - If url is invalid, Python will crash
- Object has no attributes, but two methods:
  - geturl(): Returns the url of the website
  - read(): Returns webpage HTML as a string

We Write Programs to Do Things

- Functions are the **key doers**

Function Call

- Command to **do** the function

```
greet('Walker')
```

argument to assign to n

Function Definition

- Defines what function **does**

```
def greet(n):
    print 'Hello '+n+'!'
```

Function **Header**

declaration of parameter n

Function **Body** (indented)

- **Parameter**: variable that is listed within the parentheses of a method header.
- **Argument**: a value to assign to the method parameter when it is called

Anatomy of a Function Definition

name

parameters

```
def greet(n):
    """Prints a greeting to the name n

    Precondition: n is a string
    representing a person’s name"""
    print 'Hello '+n+'!'
    print 'How are you?'
```

Function **Header**

Docstring **Specification**

Statements to execute when called

The vertical line indicates indentation

Use vertical lines when you write Python on **exams** so we can see indentation

Procedures vs. Fruitful Functions

Procedures

- Functions that **do** something
- Call them as a **statement**
- Example: `greet('Walker')`

Fruitful Functions

- Functions that give a **value**
- Call them in an **expression**
- Example: `x = round(2.56,1)`

<u>Historical Aside</u>

- Historically "function" = "fruitful function"
- But now we use "function" to refer to both

The **return** Statement

- Fruitful functions require a **return statement**
- **Format**: return <*expression*>
  - Provides value when call is used in an expression
  - Also stops executing the function!
  - Any statements after a **return** are ignored
- **Example**: temperature converter function

```
def to_centigrade(x):
    """Returns: x converted to centigrade"""
    return 5*(x-32)/9.0
```

Functions and Modules

- The purpose of modules is **function definitions**
  - Function definitions are written in module file
  - Import the module to call the functions
- Your Python workflow (right now) is

1. Write a function in a module (a .py file)
2. Open up the command shell
3. Move to the directory with this file
4. Start Python (type `python`)
5. Import the module
6. Try out the function

Aside: Constants

- Modules often have variables outside a function
  - We call these global variables
  - Accessible once you import the module
- Global variables should be **constants**
  - Variables that never, ever change
  - Mnemonic representation of important value
  - **Example**: `math.pi`, `math.e` in `math`
- In this class, constant names are **capitalized**!
  - So we can tell them apart from non-constants

Module Example: Temperature Converter

```
# temperature.py
"""Conversion functions between fahrenheit and centrigrade"""

# Functions
def to_centigrade(x):
    """Returns: x converted to centigrade"""
    return 5*(x-32)/9.0

def to_fahrenheit(x):
    """Returns: x converted to fahrenheit"""
    return 9*x/5.0+32

# Constants
FREEZING_C = 0.0    # temp. water freezes
```

Style Guideline: Two blank lines between function definitions

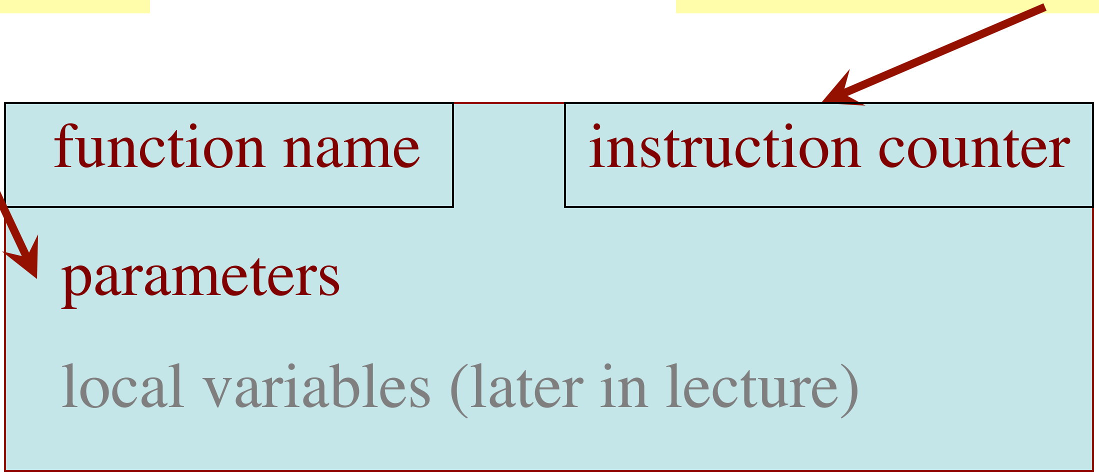
How Do Functions Work?

Draw template on a piece of paper

- **Function Frame**: Representation of function call
- A **conceptual model** of Python

Draw parameters as variables (named boxes)

- Number of statement in the function body to execute next
- **Starts with 1**



Example: to_centigrade(50.0)

1. Draw a frame for the call
2. Assign the argument value to the parameter (in frame)
3. Execute the function body
   - Look for variables in the frame
   - If not there, look for global variables with that name
4. Erase the frame for the call

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  def to_centigrade(x):
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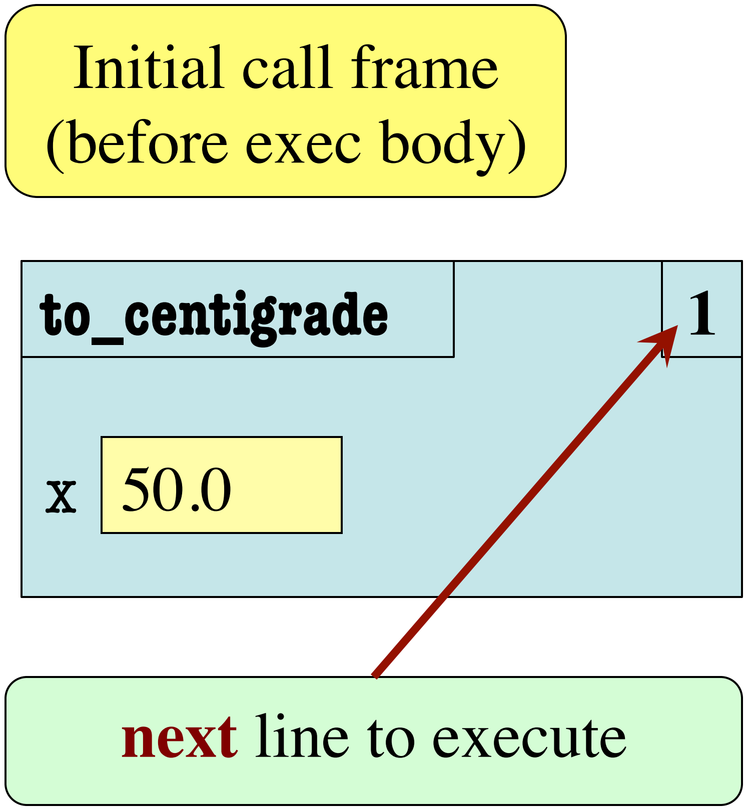

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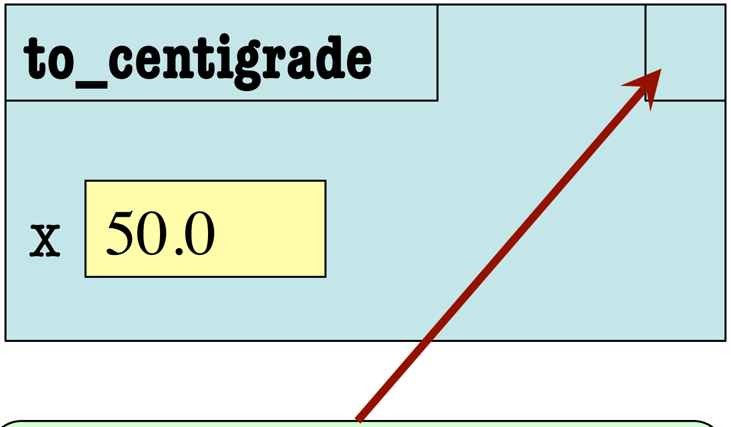
Executing the return statement



The return terminates; no next line to execute

Example: to_centigrade(50.0)

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ERASE WHOLE FRAME

But don't actually erase on an exam

Call Frames vs. Global Variables

- This does not work:

```
def swap(a,b):
    """Swap vars a & b"""
1   tmp = a
2   a = b
3   b = tmp
```

```
>>> a = 1
>>> b = 2
>>> swap(a,b)
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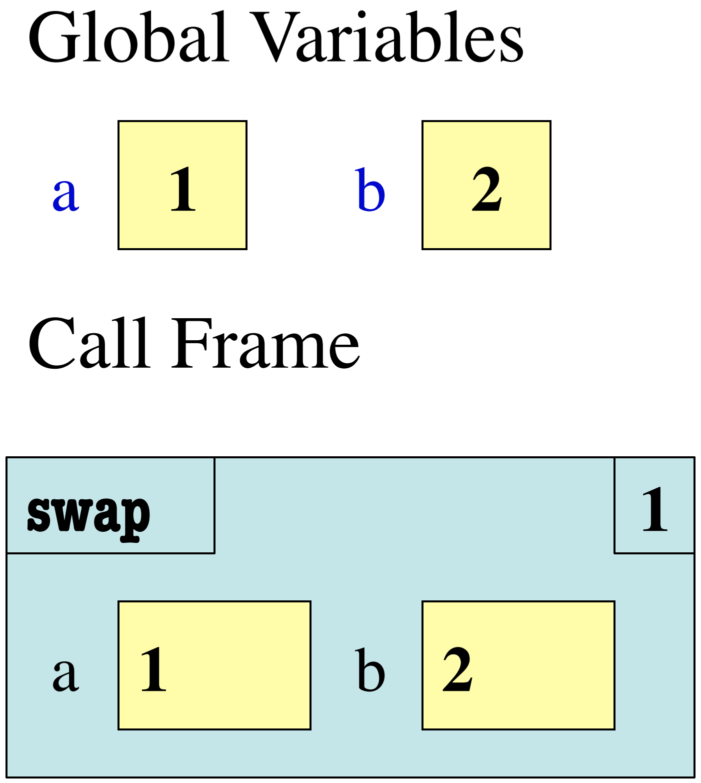

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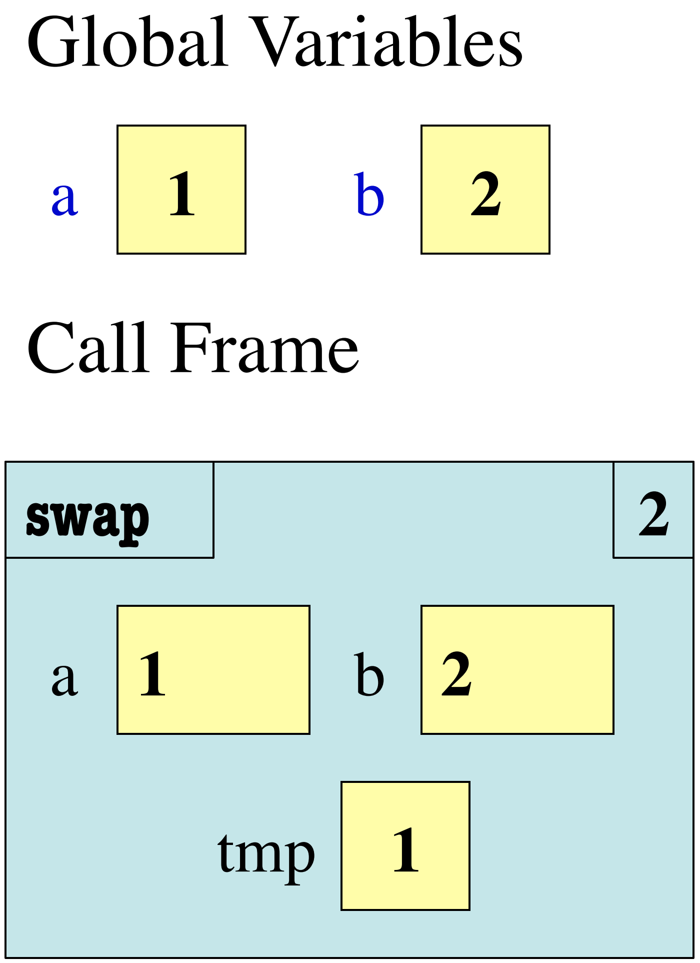

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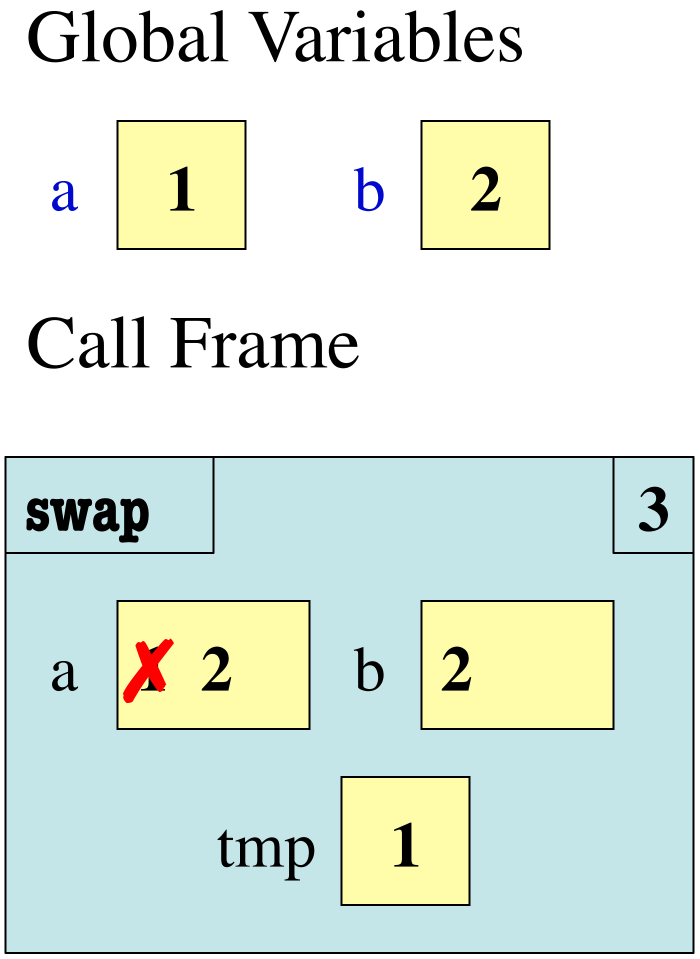

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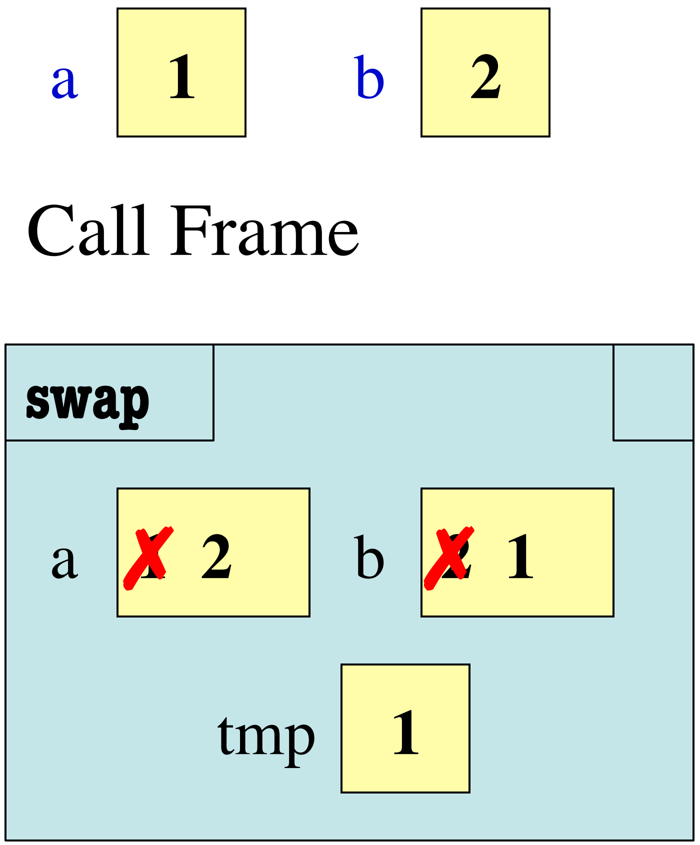
Global Variables

Call Frame

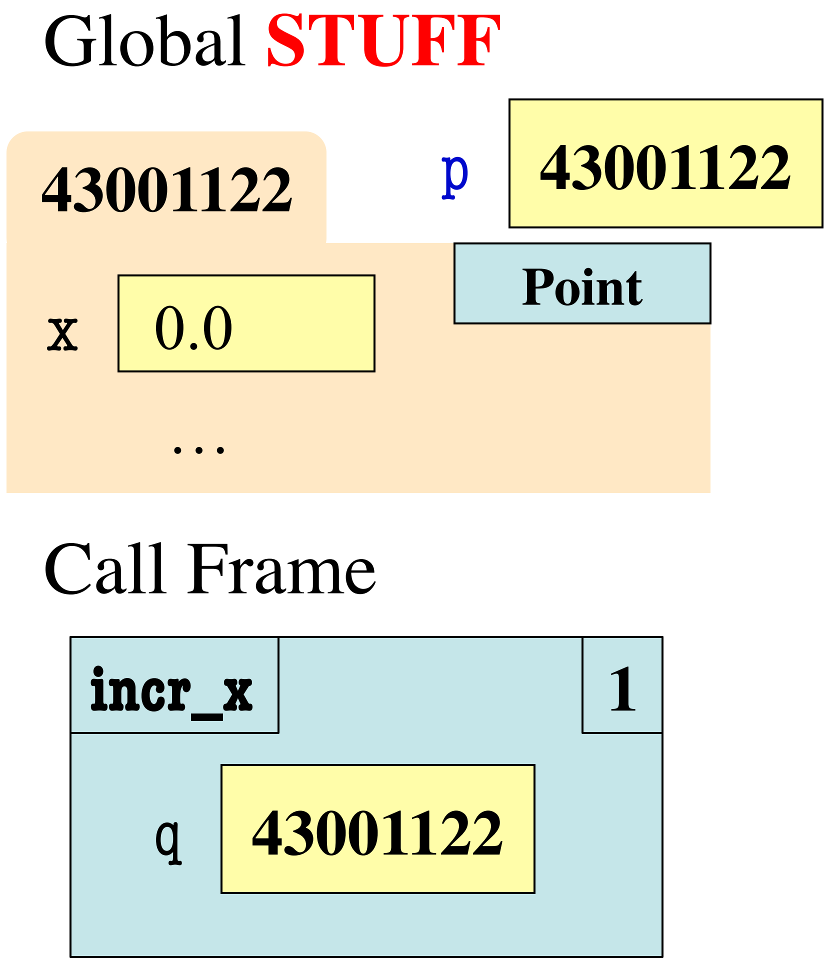


Example with Objects

- Mutable objects can be altered in a function call
  - Object vars hold names!
  - Folder accessed by both global var & parameter
- **Example**:

```
  def incr_x(q):
1     q.x = q.x + 1
```

```
>>> p = Point()
>>> incr_x(p)
```



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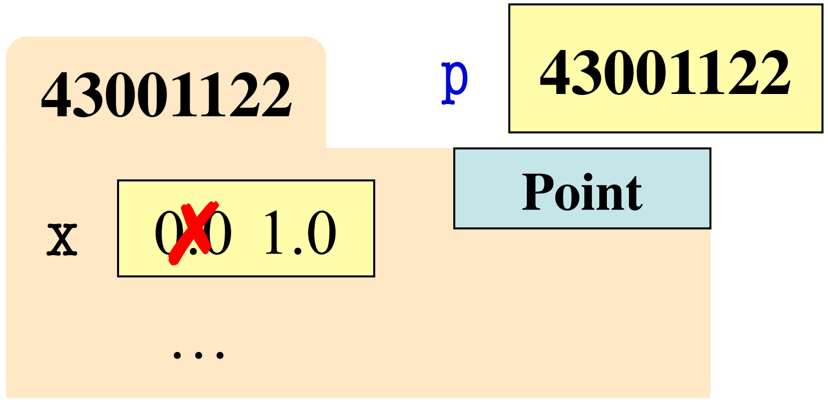
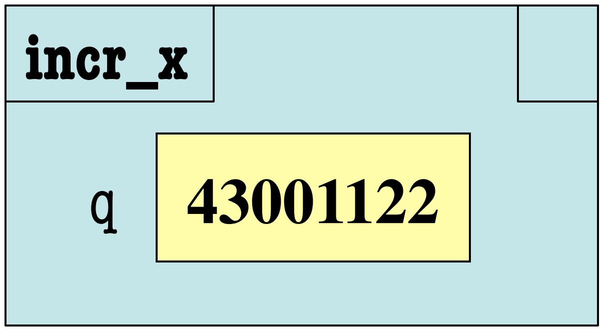
Global **STUFF**



Call Frame



incr_x
q
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