Lecture 6

Visualizing Functions

Announcements for this Lecture

Last Call

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

Assignment 1

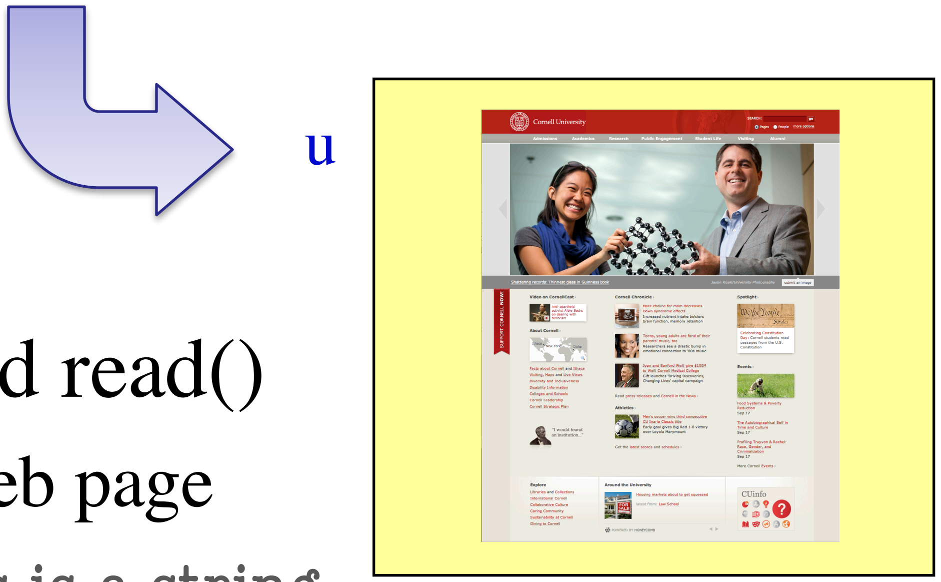
- Assignment 1 is live
  - Posted on web page
  - Due Thur, Sep. 17th
  - Due in place of Lab 4
- Lab 3 will help a lot
  - Testing is a major part
  - Try to finish it first
  - But start this Saturday!

One-on-One Sessions

- Still ongoing: 1/2-hour one-on-one sessions
  - To help prepare you for the assignment
  - **Primarily for students with little experience**
- There are still some spots available
  - Sign up for a slot in CMS
- Will keep running after **September 17**
  - Will open additional slots after the due date
  - Will help students revise Assignment 1

A1: The Module urllib2

- Module urllib2 is used to read web pages
  - Function urlopen creates a url object
  - `u = urllib2.urlopen('http://www.cornell.edu')`



- url has a method called read()
  - Returns contents of web page
  - **Usage**: `s = u.read() # s is a string`

A Motivating Example

Function Definition

```
def foo(a,b):
    """Do something
       Param a: number
       Param b: number"""
    x = a
    y = b
    return x*y+y
```

Function Call

```
>>> x = 2
>>> foo(3,4)
```

x $\boxed{?}$

What is in the box?

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x $\boxed{?}$

What is in the box?

A: 2
B: 3
C: 16
D: Nothing!
E: I do not know

A Motivating Example

Function Definition

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```

Function Call

```
>>> x = 2
>>> foo(3,4)
```

x $\boxed{?}$

What is in the box?

A: 2 **CORRECT**
B: 3
C: 16
D: Nothing!
E: I do not know

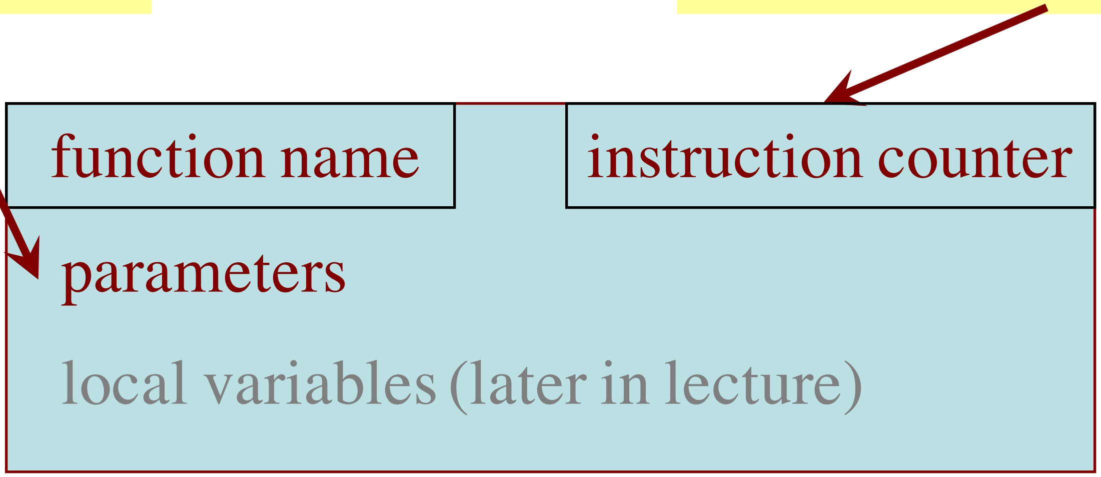
How Do Functions Work?

Draw template on a piece of paper

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

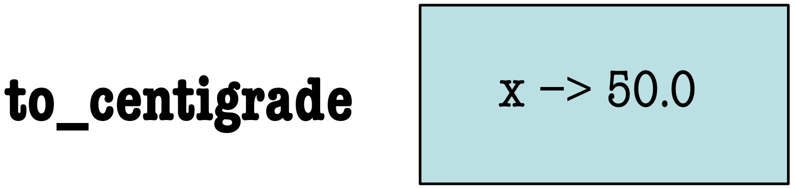
Draw parameters as variables (named boxes)

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

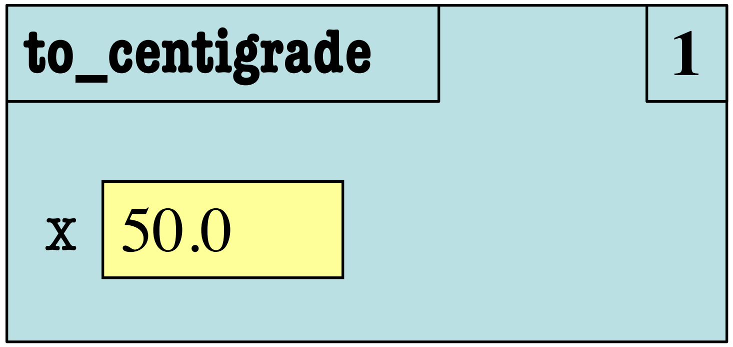


Text (Section 3.10) vs. Class

Textbook



This Class



Definition:

```
def to_centigrade(x):
    return 5*(x-32)/9.0
```

Call: to_centigrade(50.0)

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

```
  def to_centigrade(x):
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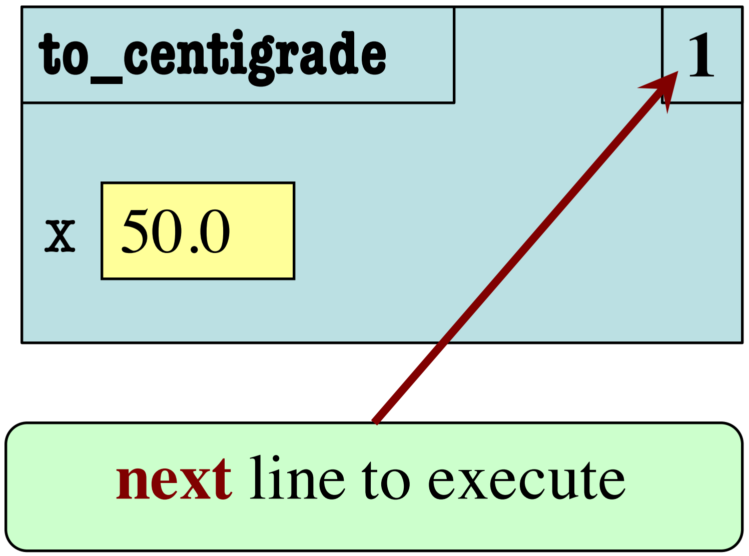
Initial call frame (before exec body)



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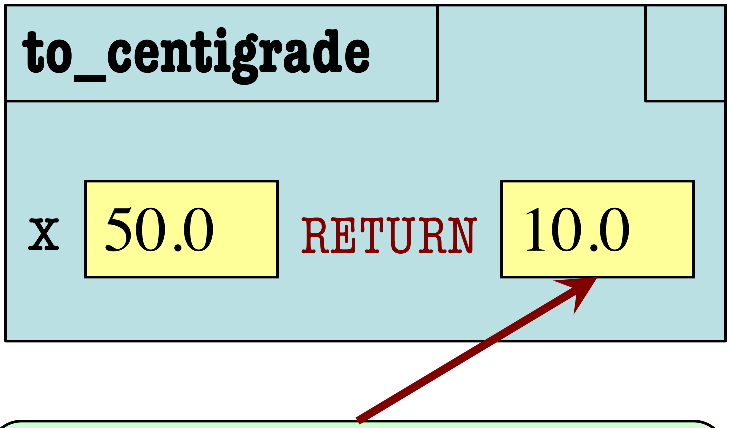
Executing the return statement



Return statement creates a special variable for result

Example: to_centigrade(50.0)

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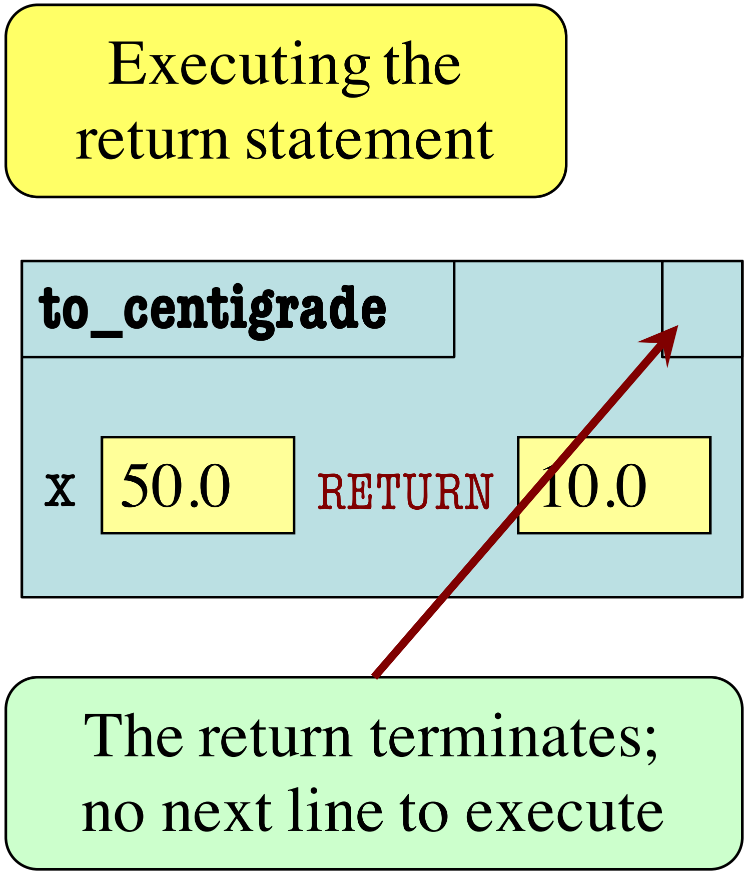

Executing the return statement

The return terminates; no next line to execute

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ERASE WHOLE FRAME

But don't actually erase on an exam

Call Frames vs. Global Variables

The specification is a **lie**:

```
    def swap(a,b):
        """Swap global a & b"""
1       tmp = a
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```

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>>> a = 1
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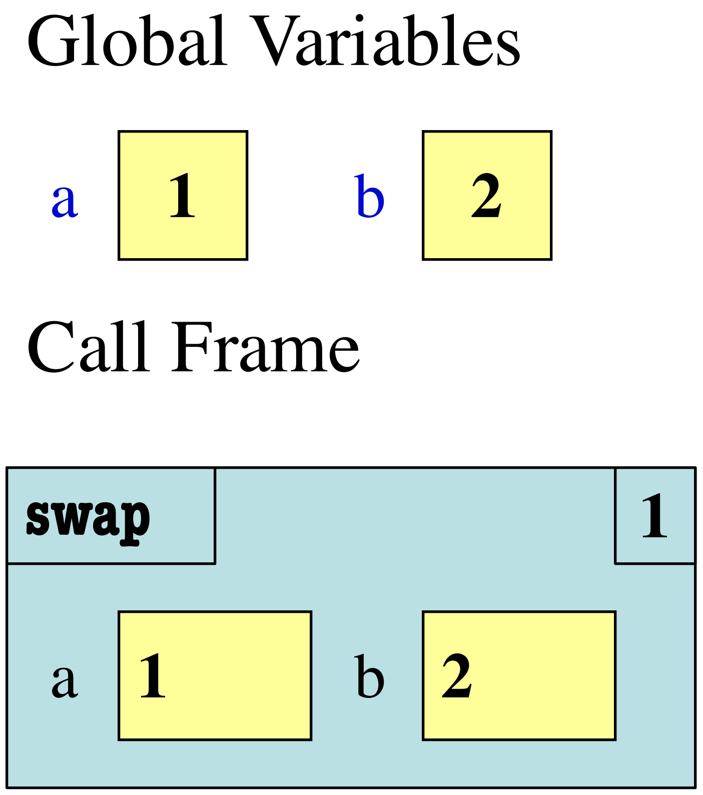

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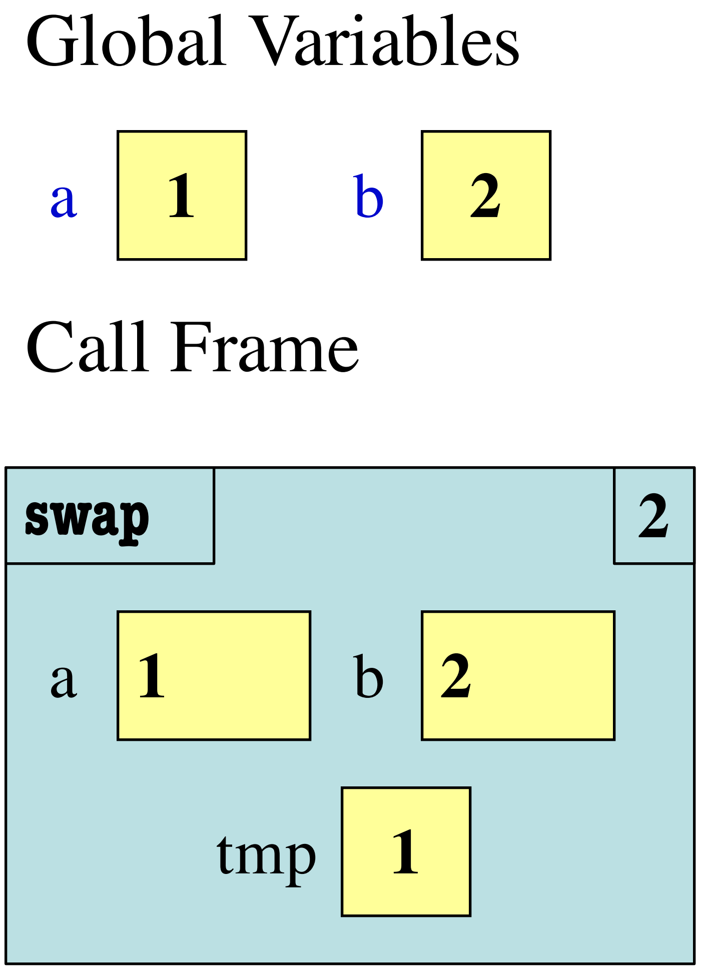

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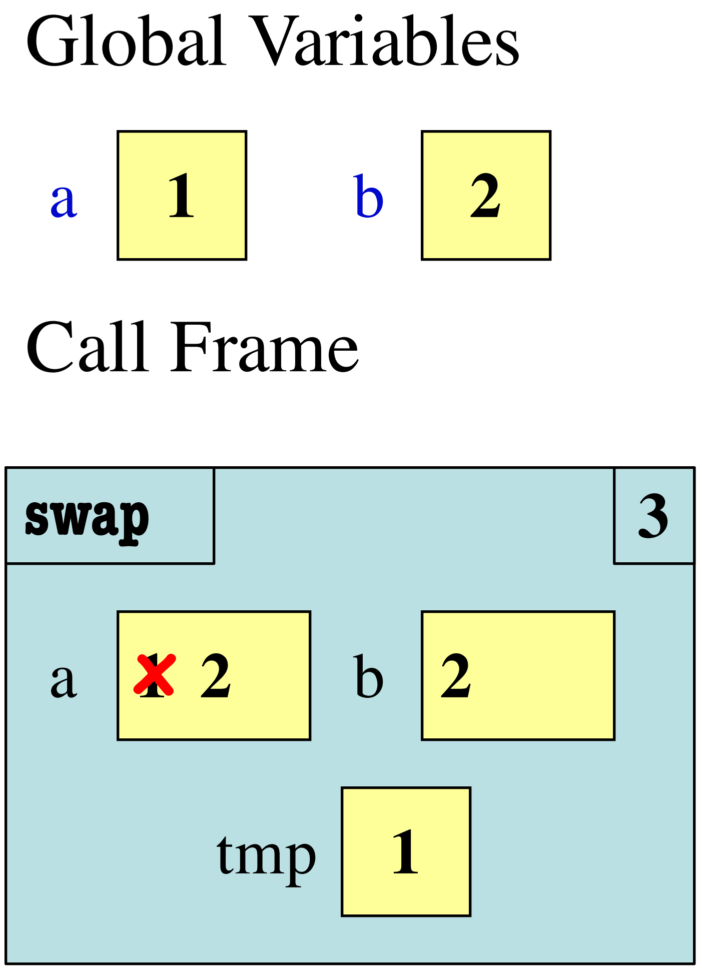

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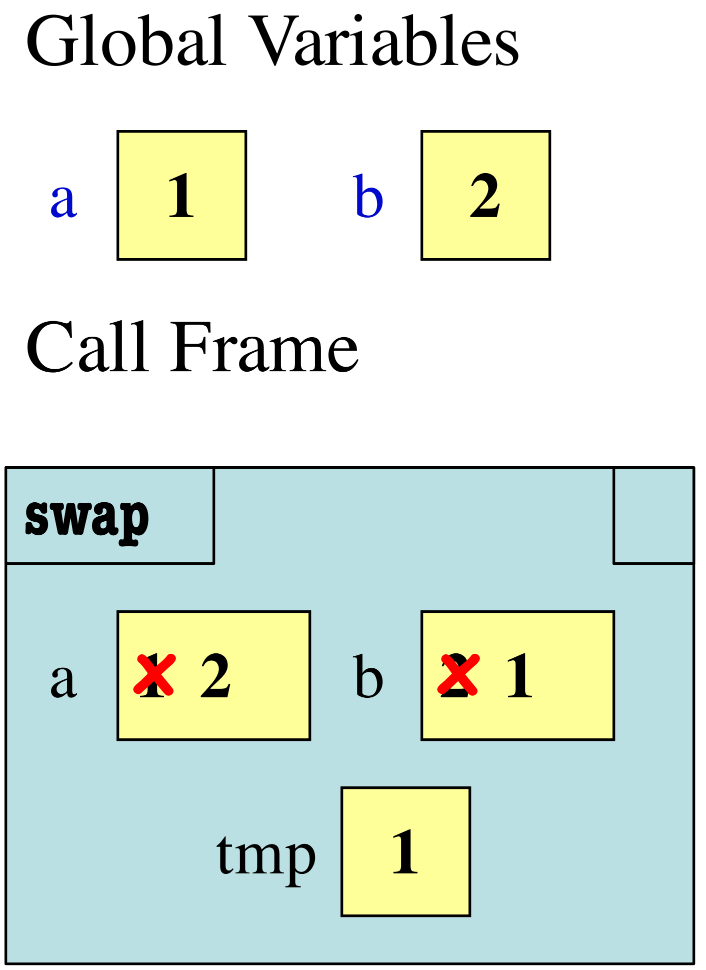

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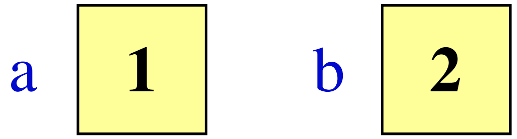
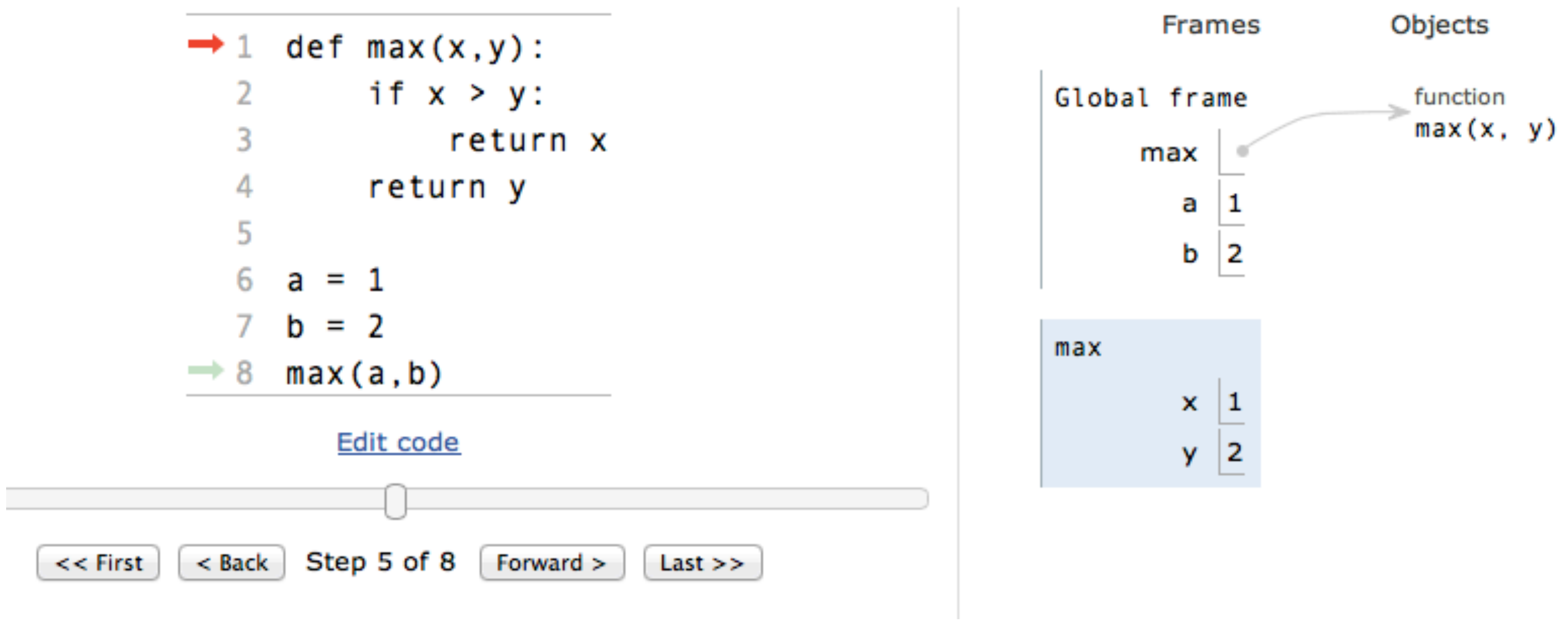
Global Variables



Call Frame

ERASE THE FRAME

Visualizing Frames: The Python Tutor



```
def max(x,y):
    if x > y:
        return x
    return y

a = 1
b = 2
max(a,b)
```

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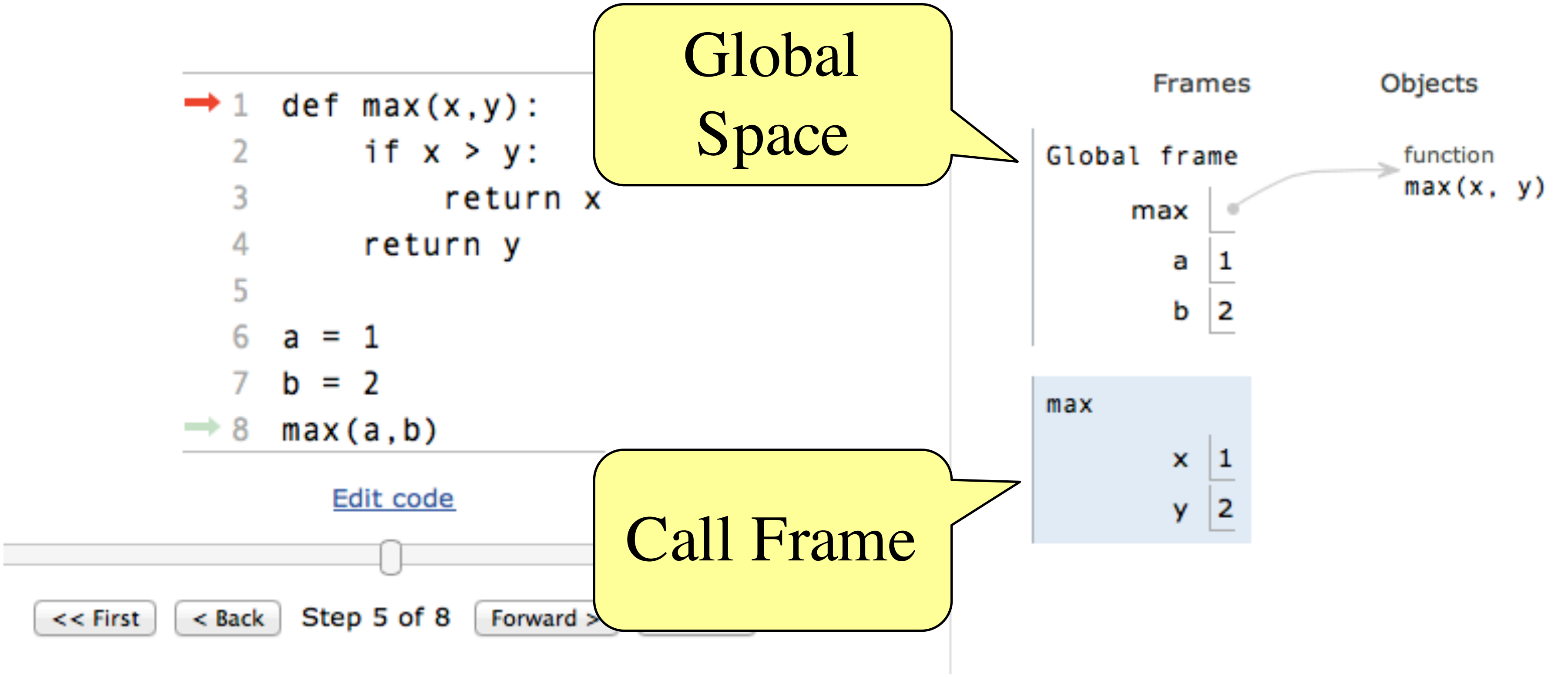

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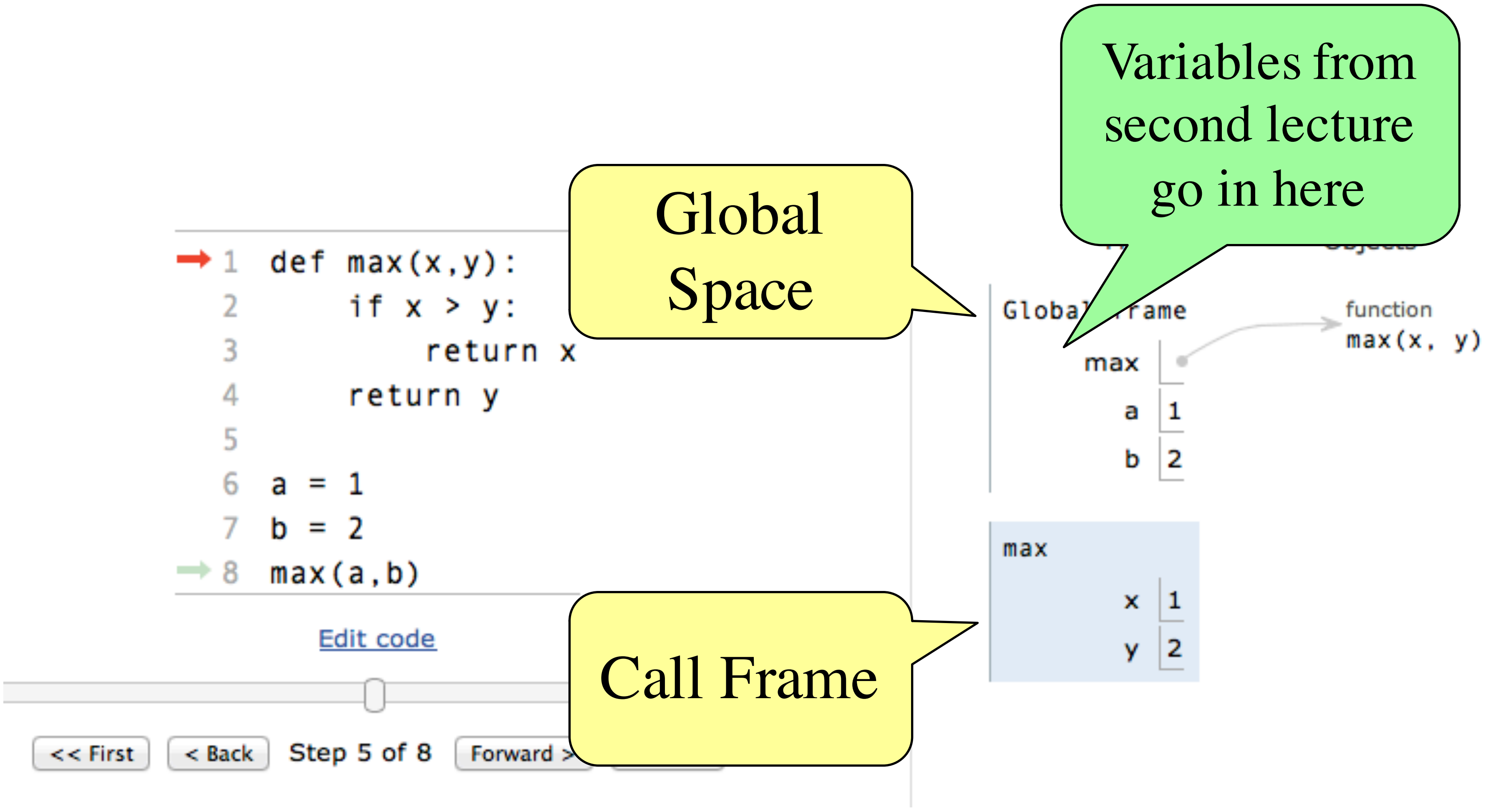

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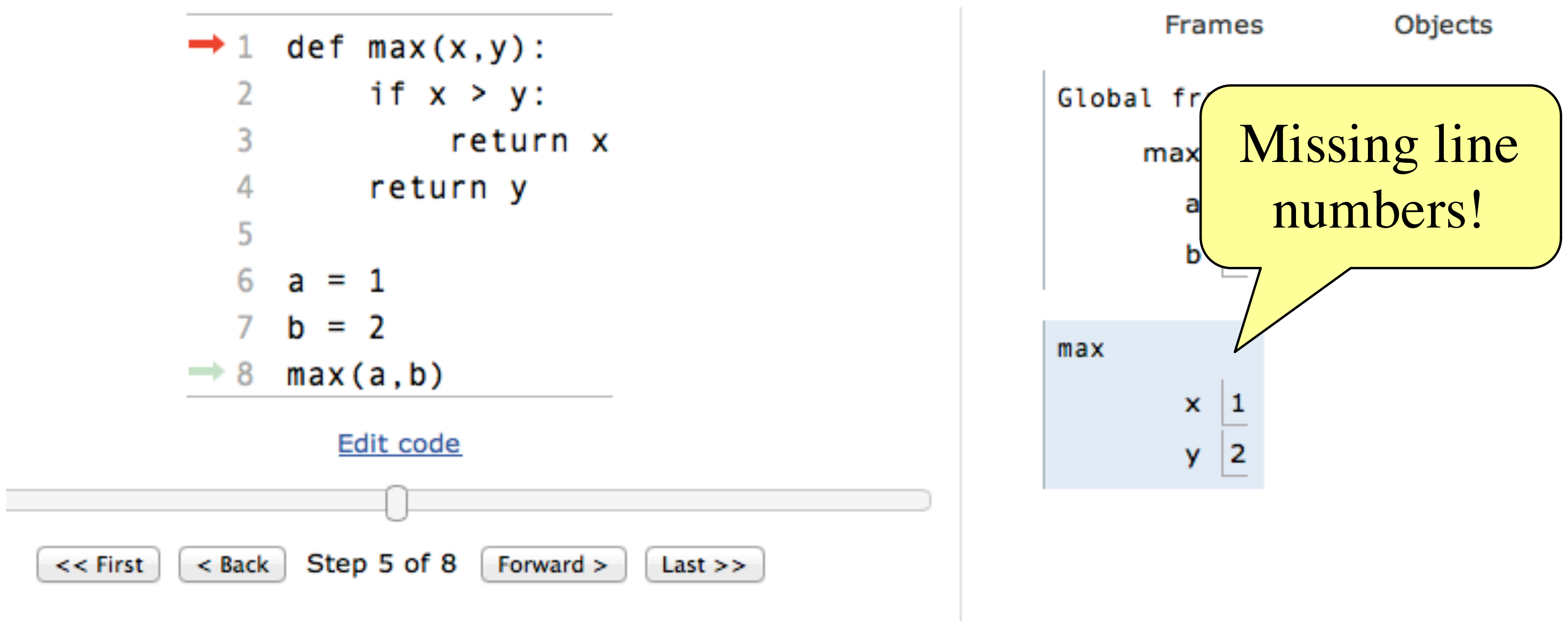

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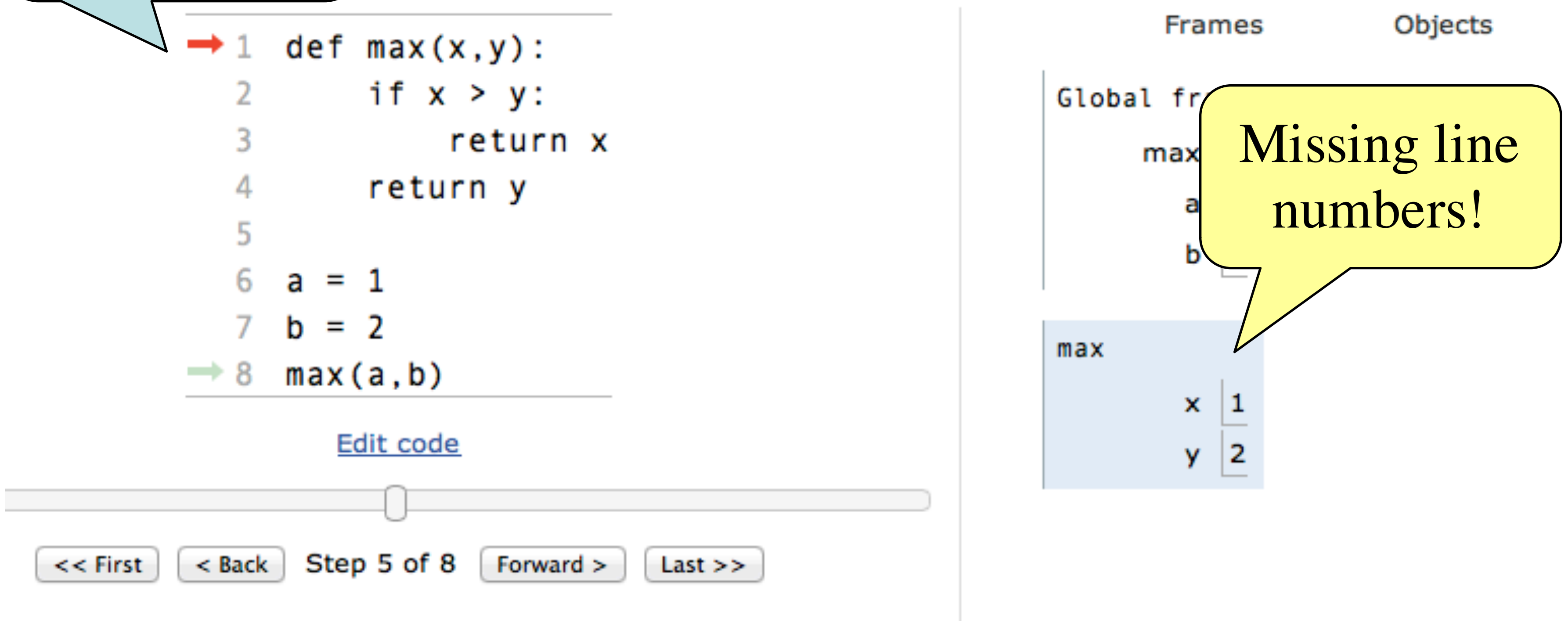
max(a,b)
```

Missing line numbers!

Visualizing Frames: The Python Tutor

Line number marked here (sort-of)



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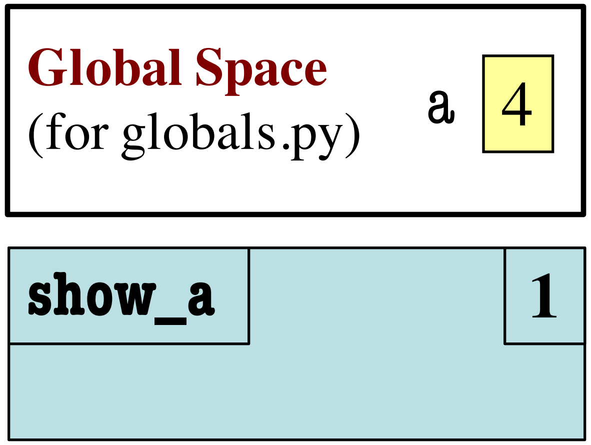
Missing line numbers!

Function Access to Global Space

- All function definitions are in some module
- Call can access global space for **that module**
  - math.cos: global for math
  - temperature.to_centigrade uses global for temperature
- But **cannot** change values
  - Assignment to a global makes a new local variable!
  - Why we limit to constants



```
# globals.py
"""Show how globals work"""
a = 4 # global space


def show_a():
    print a # shows global
```

Function Access to Global Space

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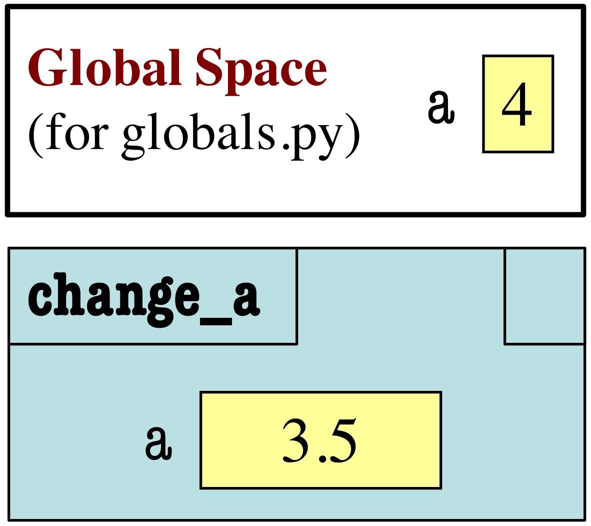


```
# globals.py
"""Show how globals work"""
a = 4 # global space


def change_a():
    a = 3.5 # local variable
```

Exercise Time

Function Definition

```
def foo(a,b):
    """Do something
       Param x: a number
       Param y: a number"""
1   x = a
2   y = b
3   return x*y+y
```

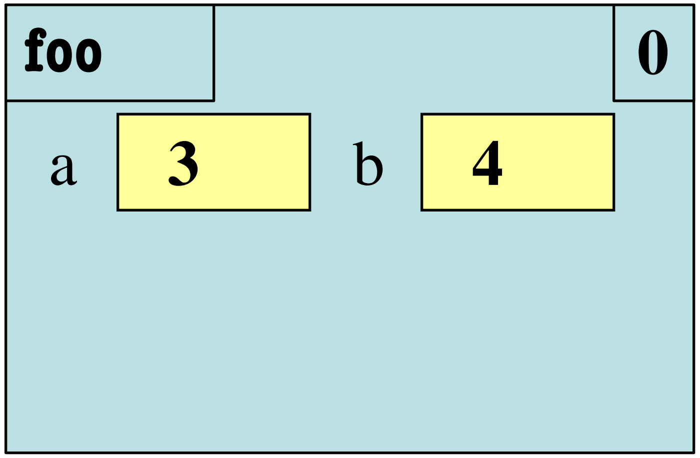
Function Call

```
>>> x = foo(3,4)
```

What does the frame look like at the **start**?

Which One is Closest to Your Answer?

A:



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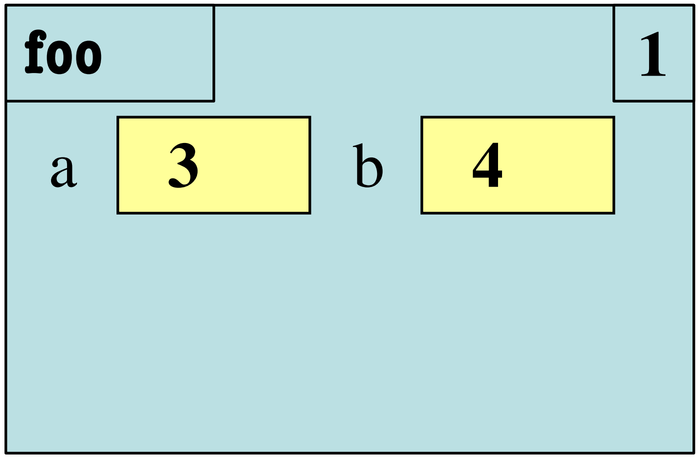

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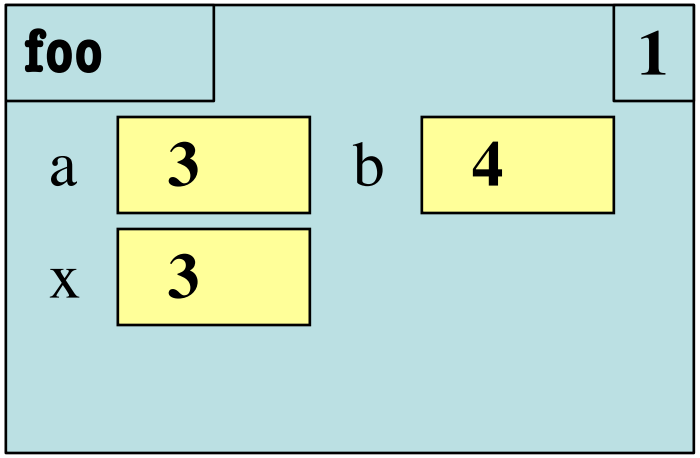

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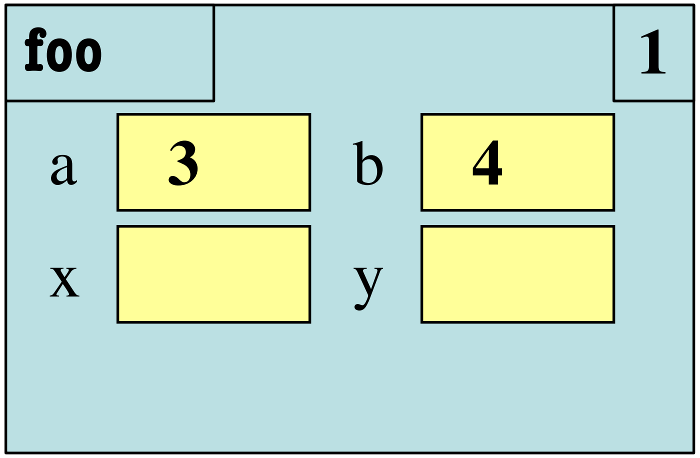

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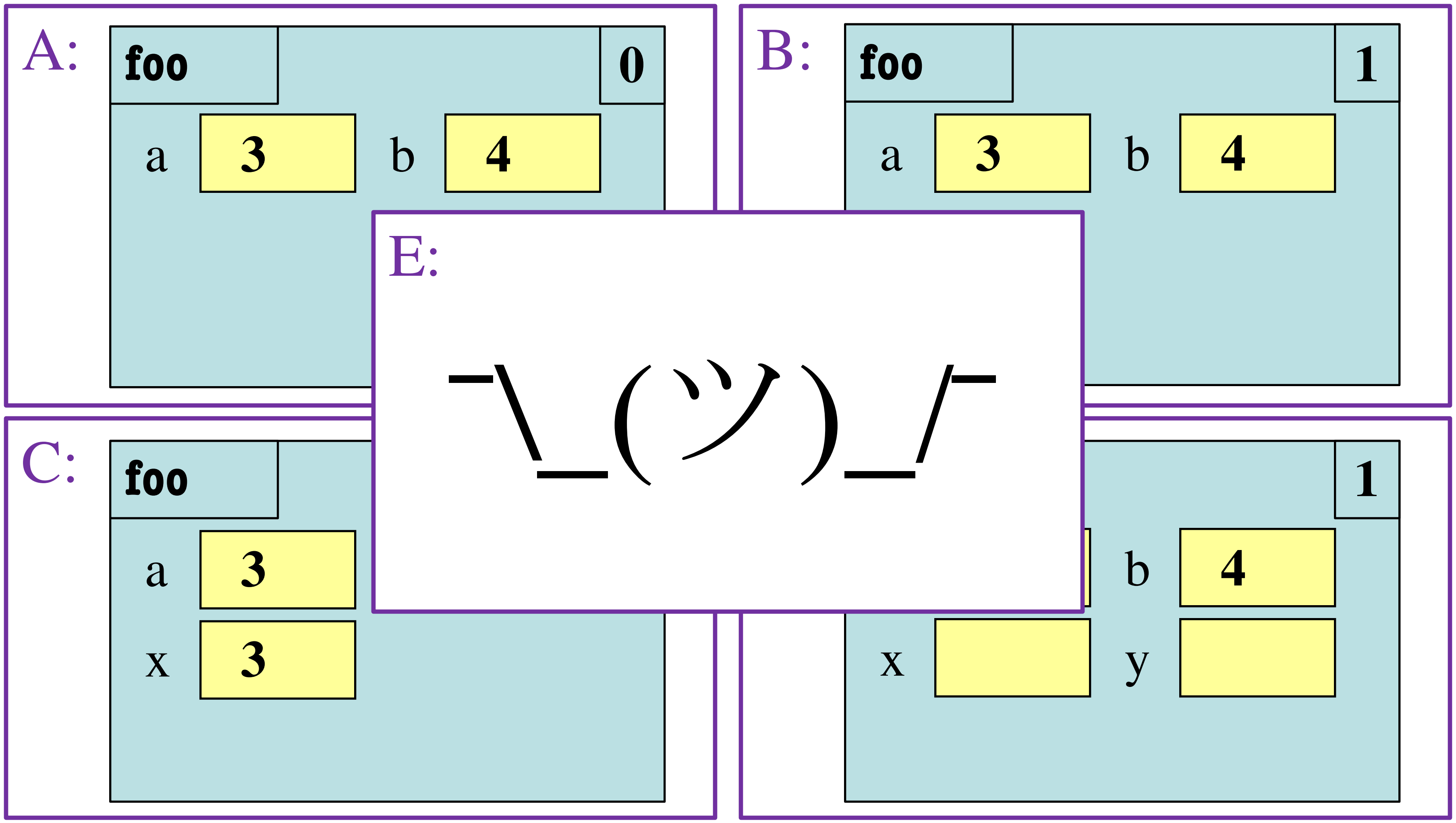

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Function Call

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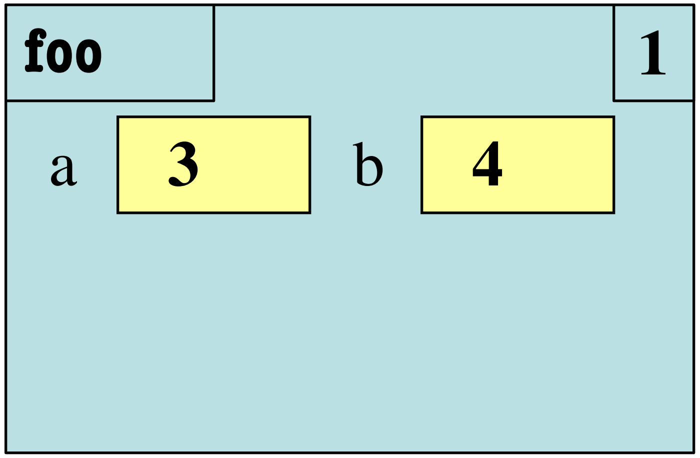

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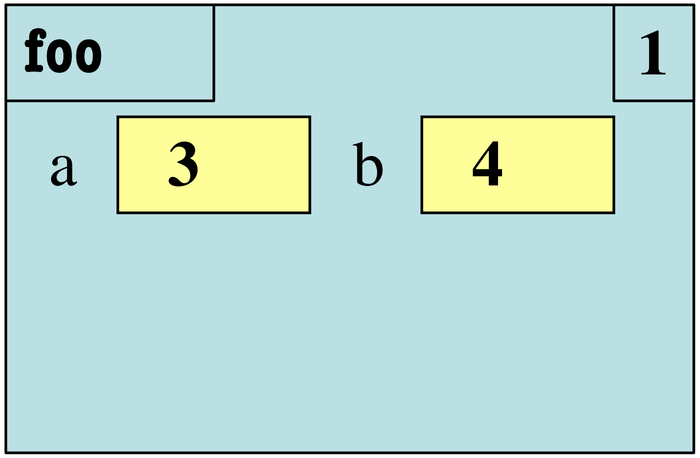

What is the **next step**?

Which One is Closest to Your Answer?

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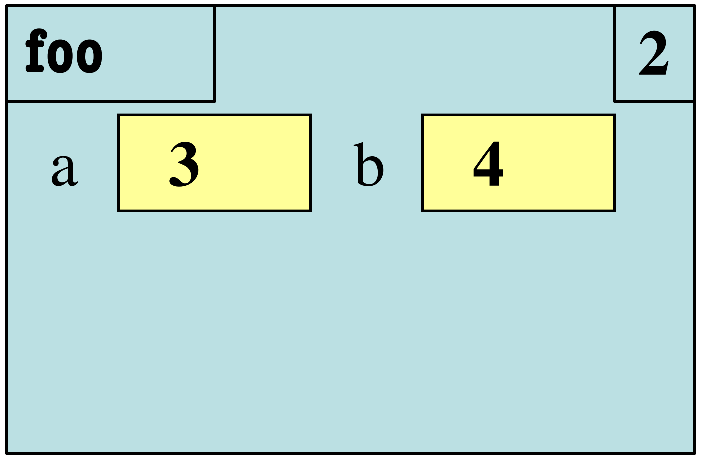

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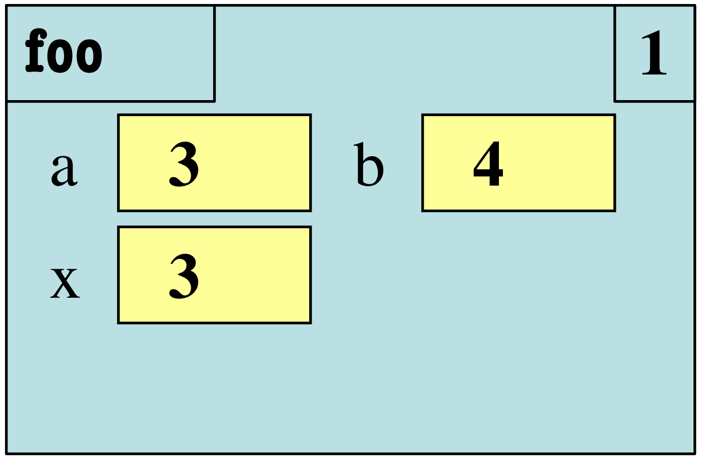

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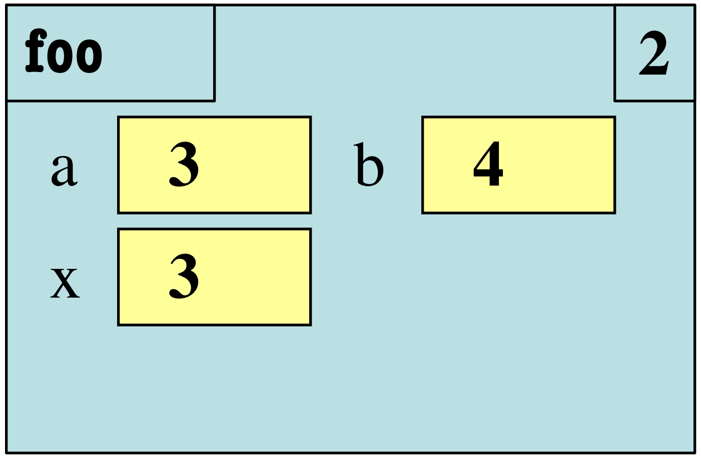
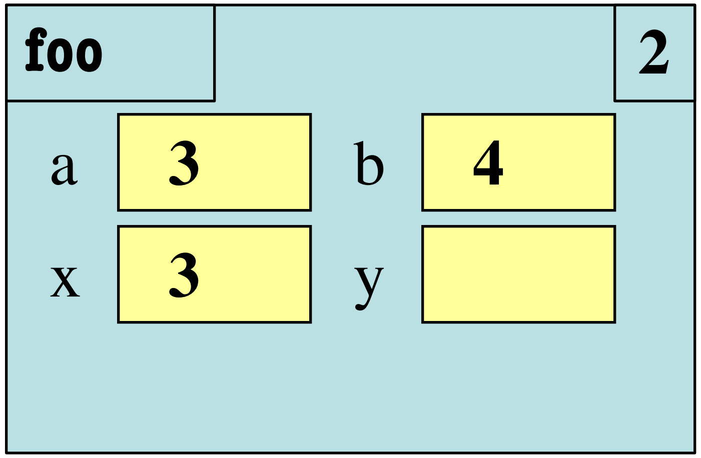


D:



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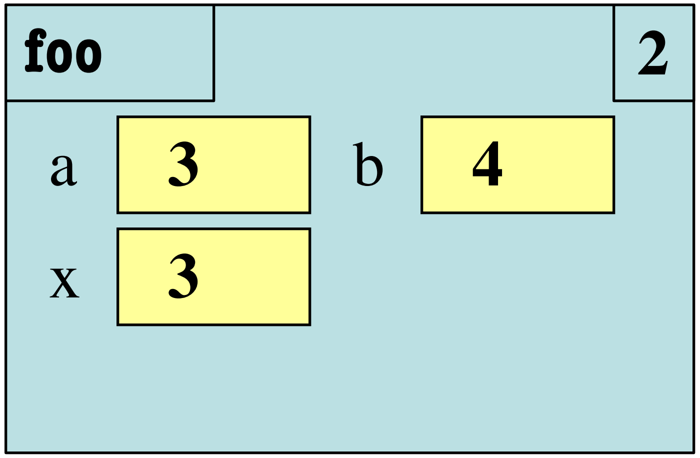

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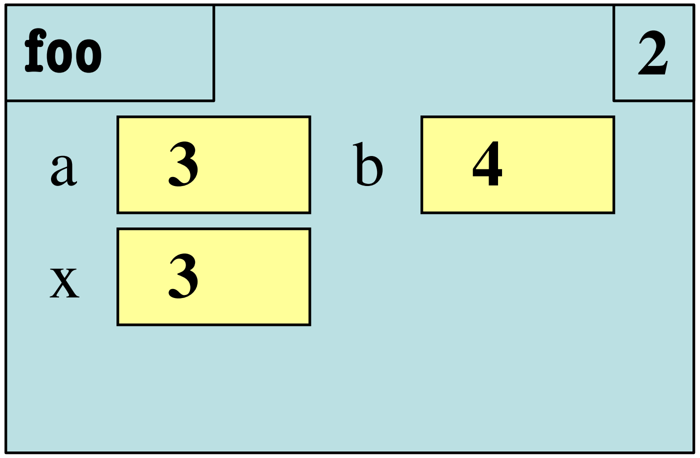

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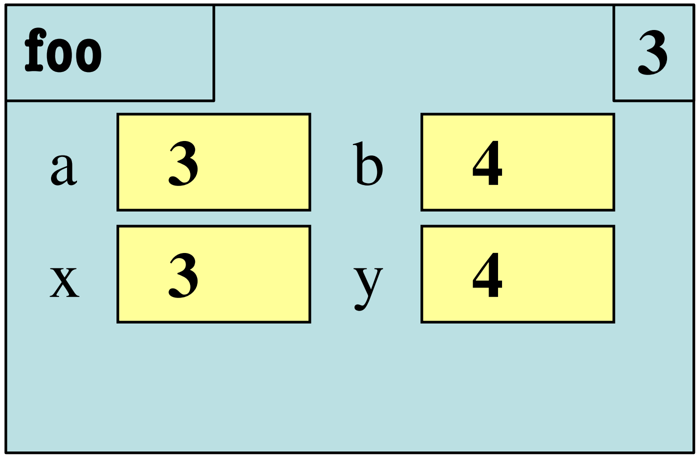

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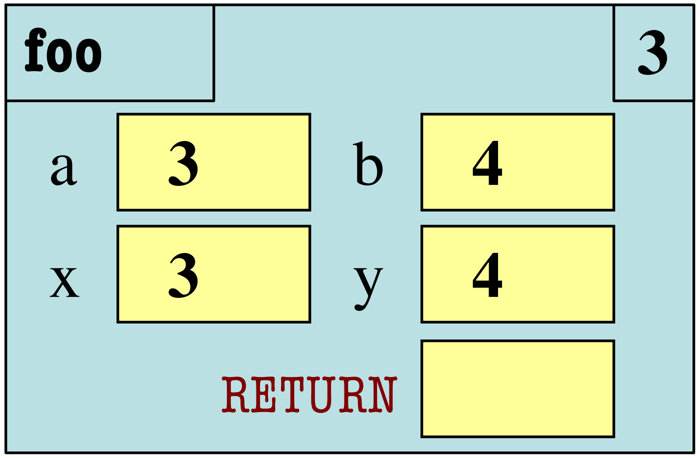

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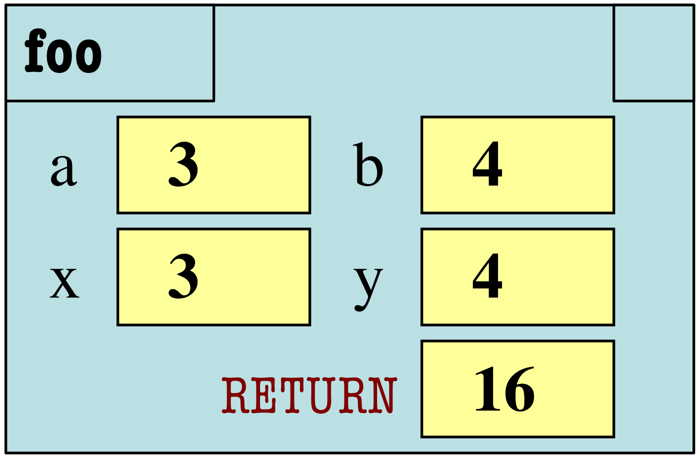

D:

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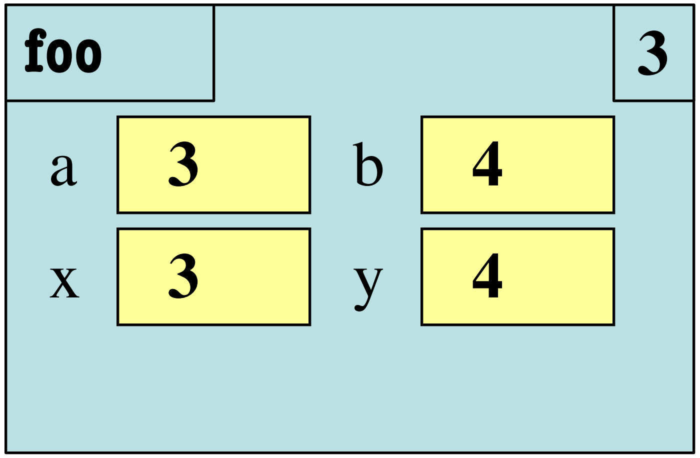

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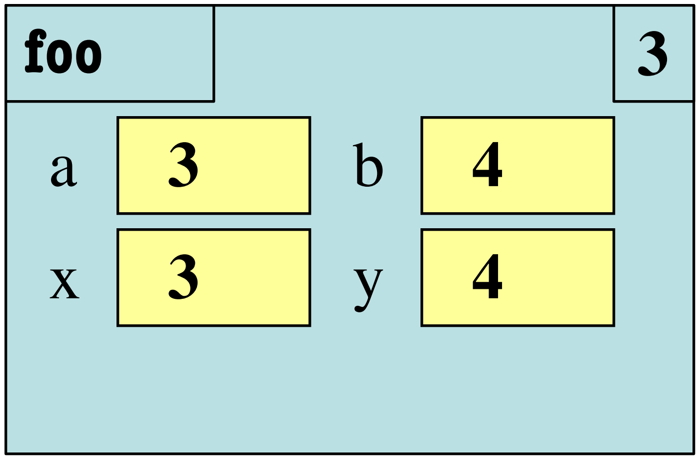

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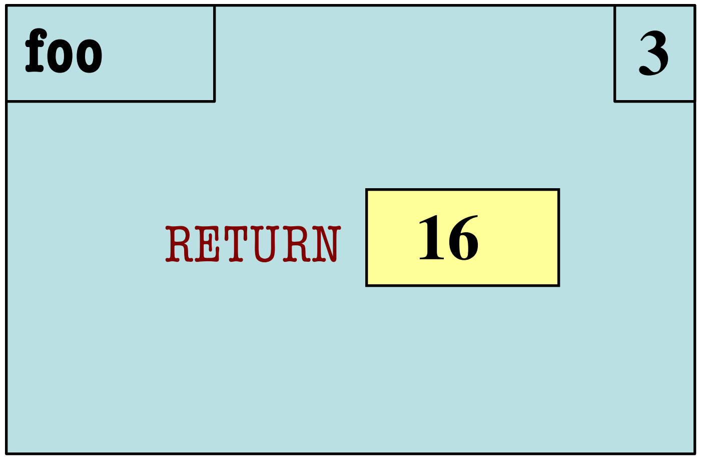

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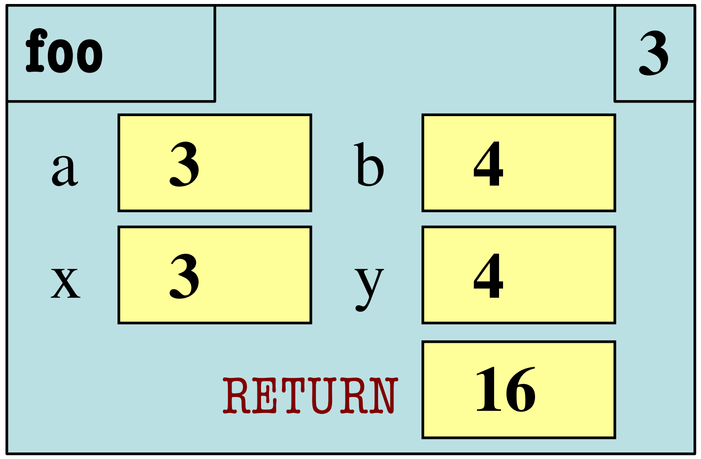

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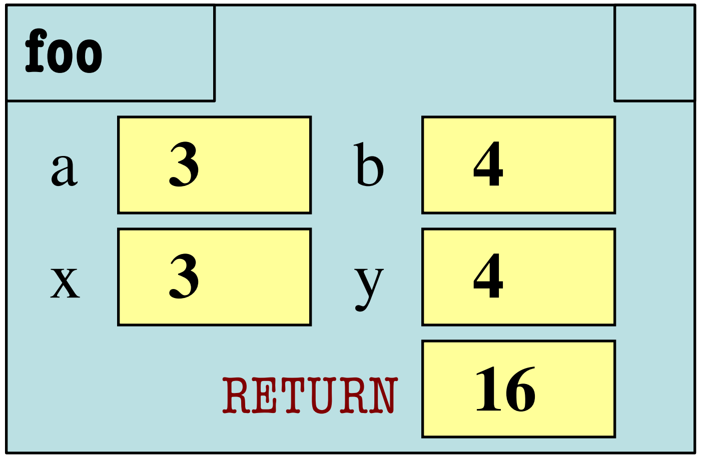

D:

ERASE THE FRAME

Exercise Time

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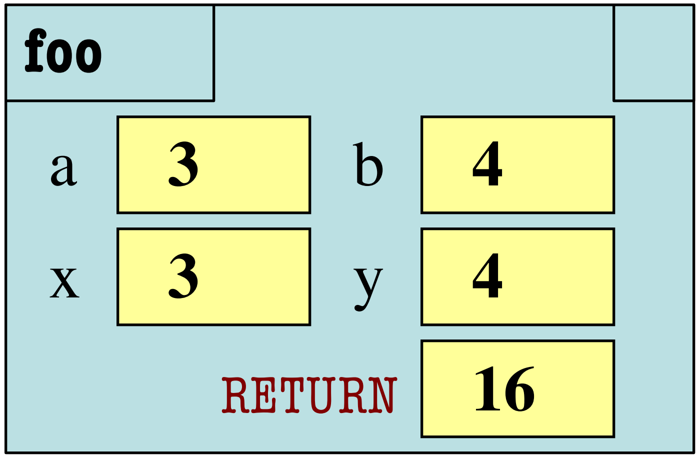

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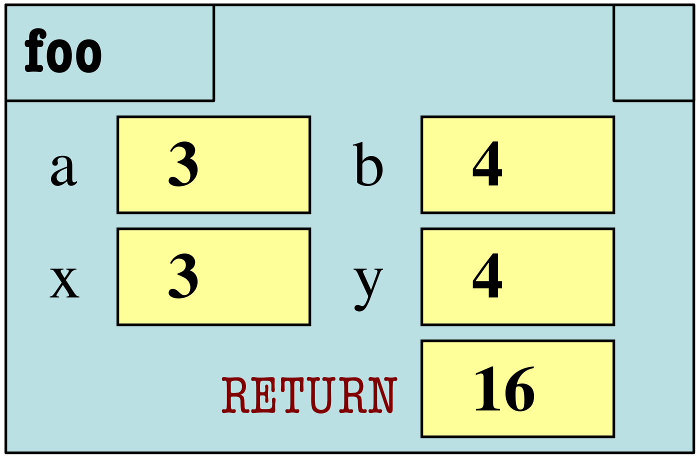

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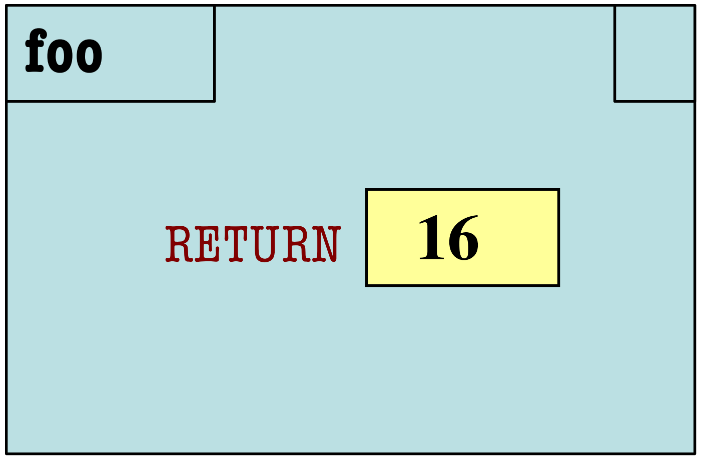

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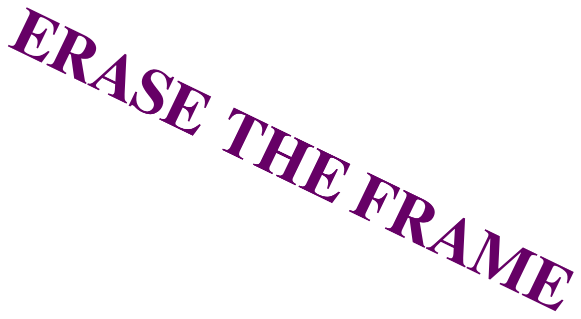
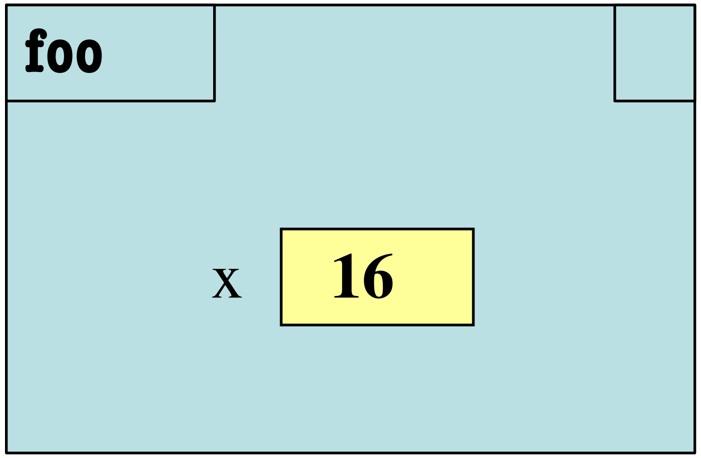
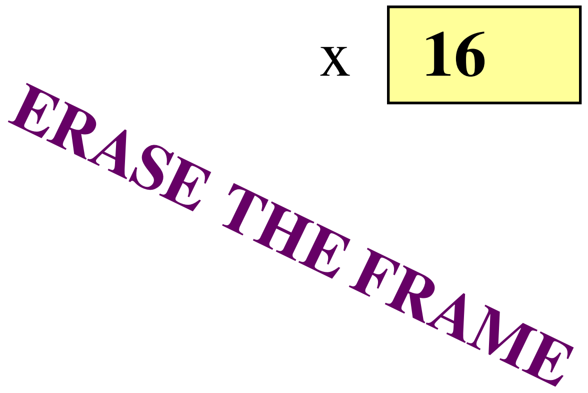


C:



D:



Exercise Time

Function Definition

```
def foo(a,b):
    """Do something
       Param x: a number
       Param y: a number"""
1   x = a
2   y = b
3   return x*y+y
```

Function Call

```
>>> x = foo(3,4)
```

D:

x $\boxed{16}$

ERASE THE FRAME

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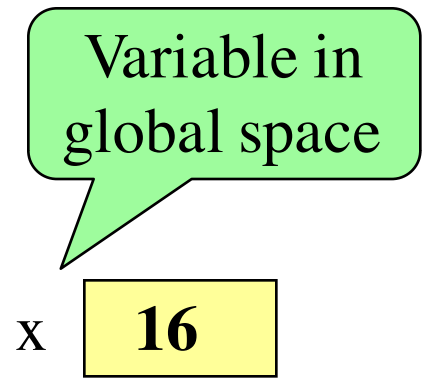

ERASE THE FRAME