Lecture 4

Defining Functions

Announcement: Partner Finding Social

- **Reminder:** Assignments can be done in **pairs**
  - Can work with anyone in class (in any section)
  - Can change partners every assignment
- Having a mixer to help find a partner
  - 4-6pm Tuesday, September 6th
  - Upson Lounge (adjacent to Duffield)
- Please **register** if you are coming
  - Need to know how much food to have
  - Link will be posted on Ed Discussions

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- Please **regist**
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Academic Integrity Quiz

- **Remember**: quiz about the course AI policy
  - Have posted grades for completed quizes
  - Right now, missing ~40 enrolled students
  - If did not receive 9/10 (~124 students), take it again
- If you are not aware of the quiz
  - Go to http://www.cs.cornell.edu/courses/cs1110/
  - Click **Academic Integrity** under **Assessments**
  - Read and take quiz in CMS

Recall: Modules

- Modules provide extra functions, variables
  - **Example**: `math` provides `math.cos()`, `math.pi`
  - Access them with the `import` command
- Python provides a lot of them for us
- **This Lecture**: How to make modules
  - VS Code to *make* a module
  - Python to *use* the module

Two different programs

We Write Programs to Do Things

- Functions are the **key doers**

Function Call

- Command to **do** the function

```
>>> plus(23)
24
>>>
```

Function Definition

- Defines what function **does**

```
def plus(n):
    return n+1
```

- **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

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Function **Header**

Function **Body** (indented)

- **Parameter**: variable that is listed within the parentheses of a method header.
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We Write Programs to Do Things

- Functions are the **key doers**

Function Call

- Command to **do** the function

```
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```

argument to assign to n

Function Definition

- Defines what function **does**

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def plus(n):
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Function **Header**

declaration of **parameter** n

Function **Body** (indented)

- **Parameter**: variable that is listed within the parentheses of a method header.
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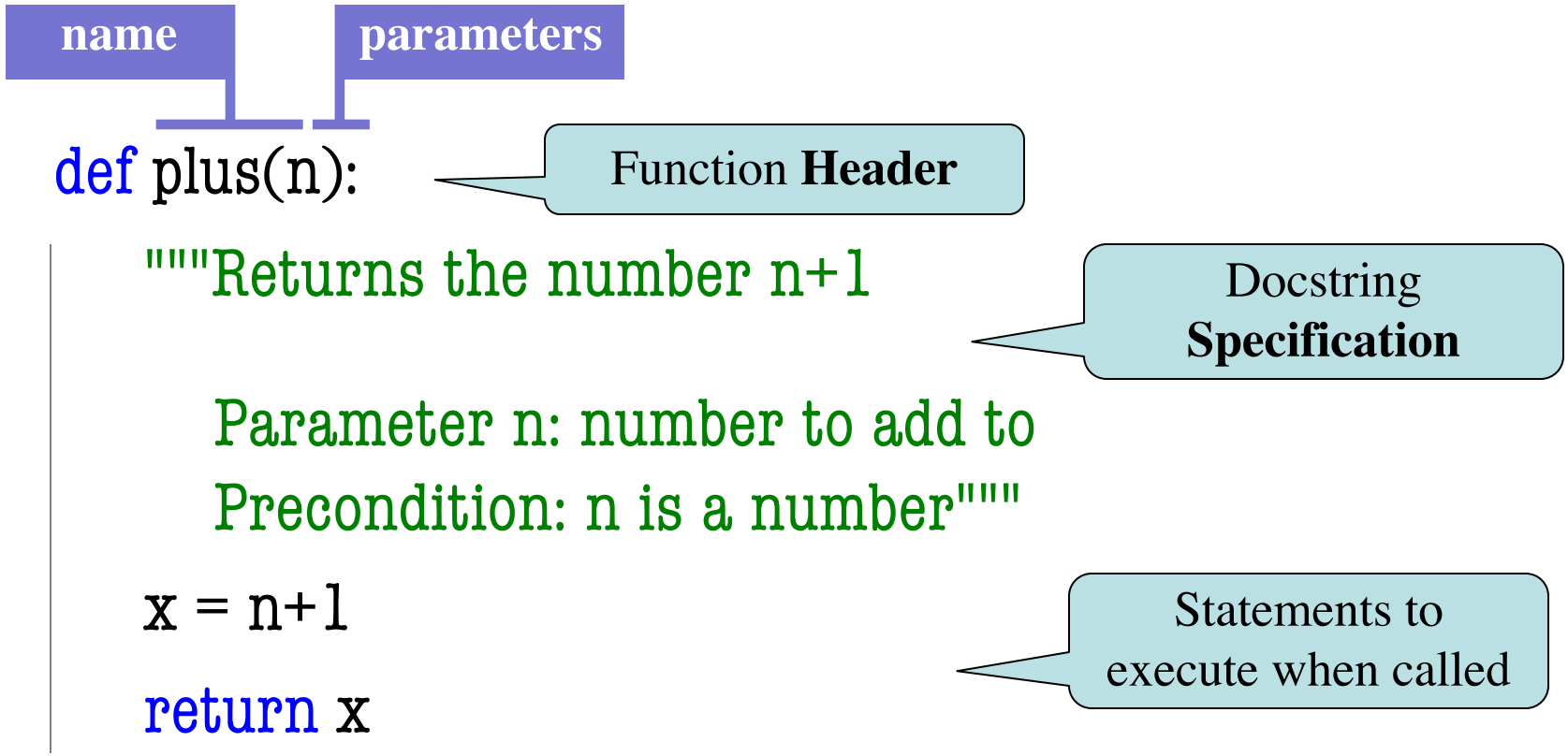
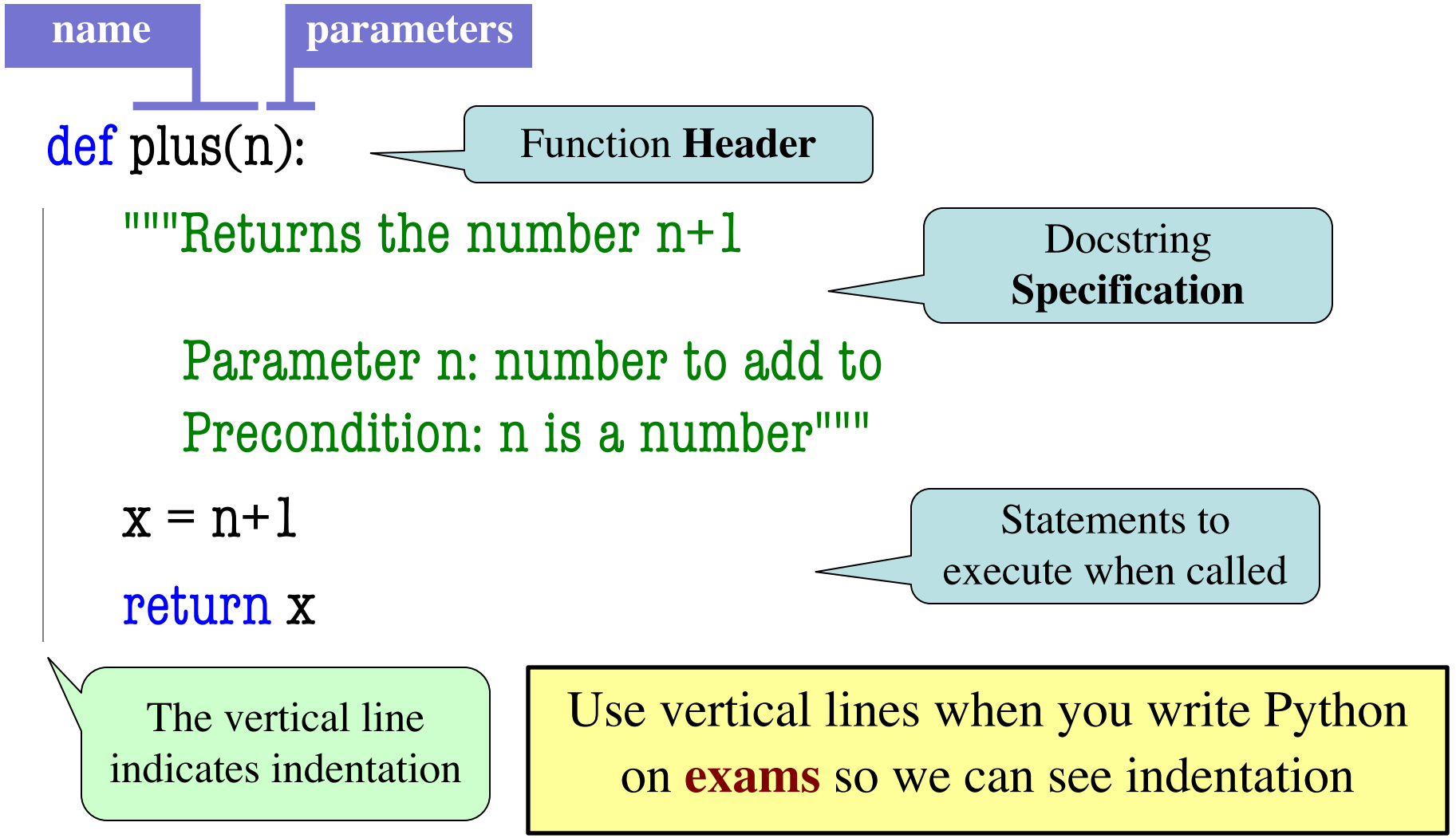
Anatomy of a Function Definition



Anatomy of a Function Definition



The **return** Statement

- **Format**: return <*expression*>
  - Used to evaluate ***function call*** (as 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
```

A More Complex Example

Function Definition

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

Function Call

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

x ?

What is in the box?

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What is in the box?

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

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What is in the box?

A: 2 **CORRECT**
B: 3
C: 16
D: Nothing!
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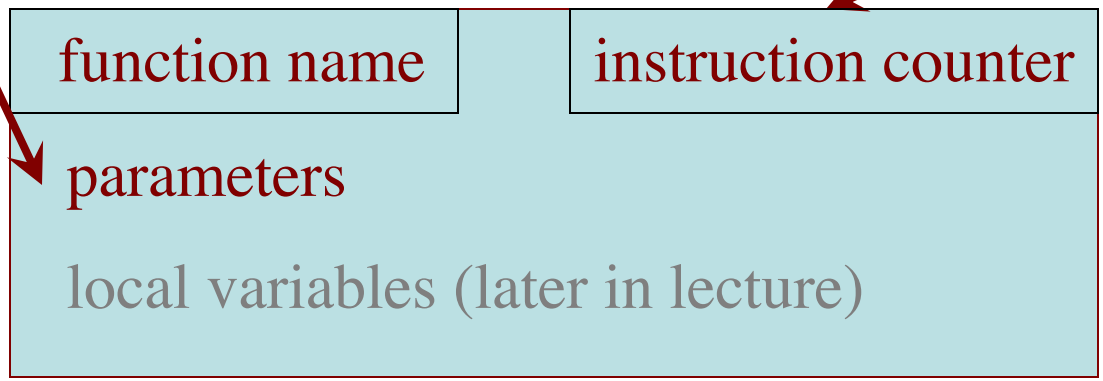
Understanding How Functions Work

- **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 line no. of body**



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
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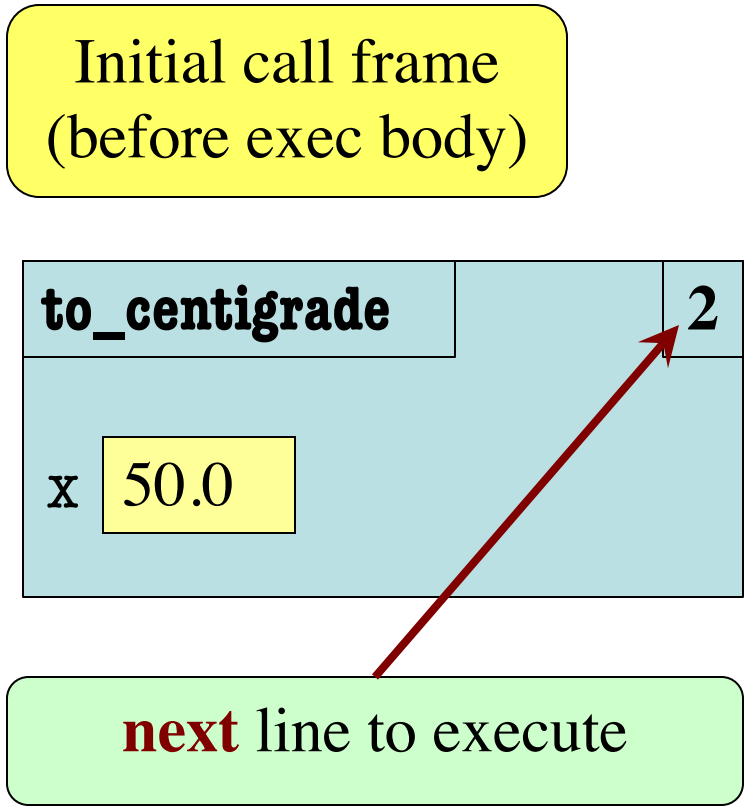

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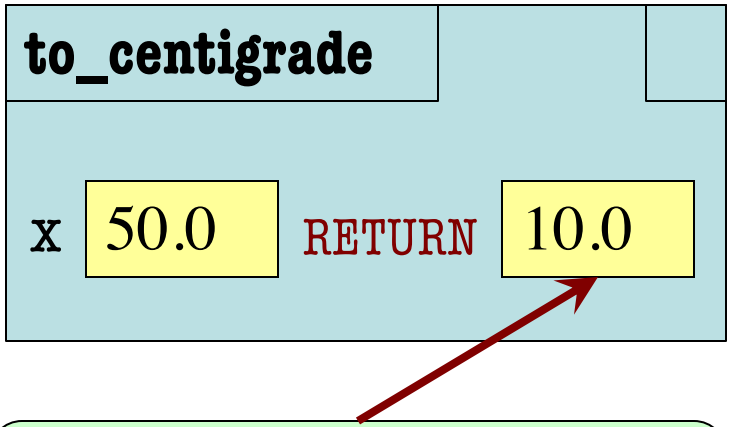
Executing the return statement



Return statement creates a special variable for result

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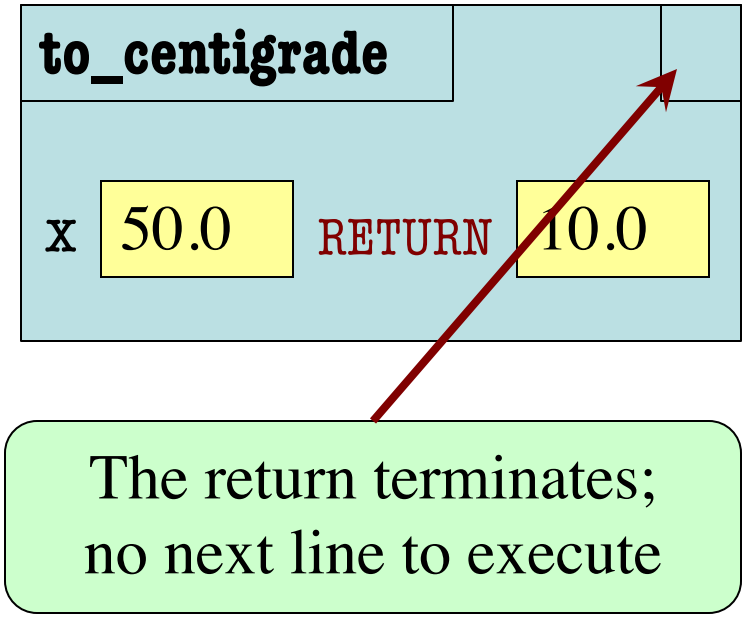

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ERASE WHOLE FRAME

But don't actually erase on an exam

Call Frames vs. Global Variables

The specification is a **lie**:

```
1  def swap(a,b):
2      """Swap global a & b"""
3      tmp = a
4      a = b
5      b = tmp
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```
>>> a = 1
>>> b = 2
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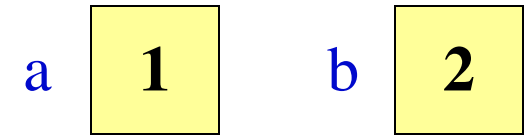
Global Variables



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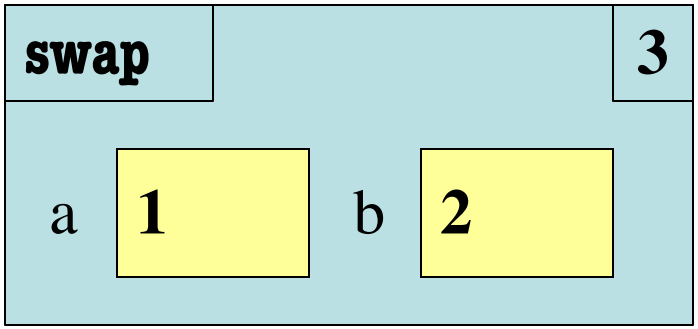

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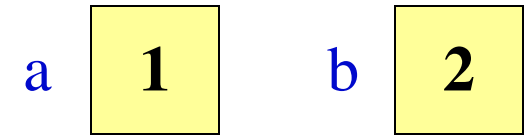

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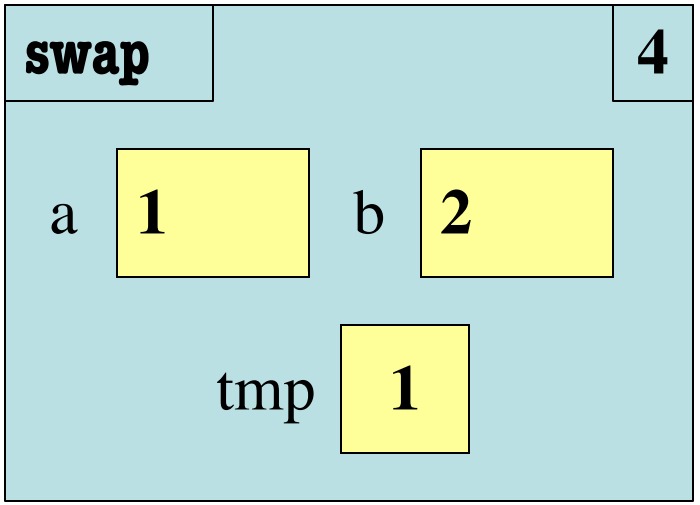

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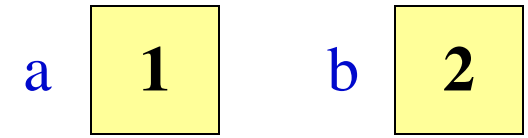

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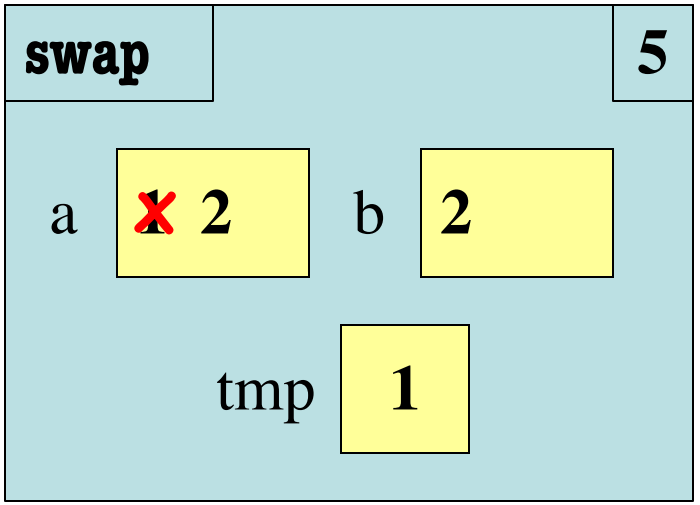

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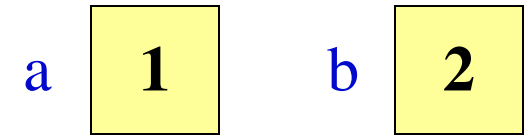

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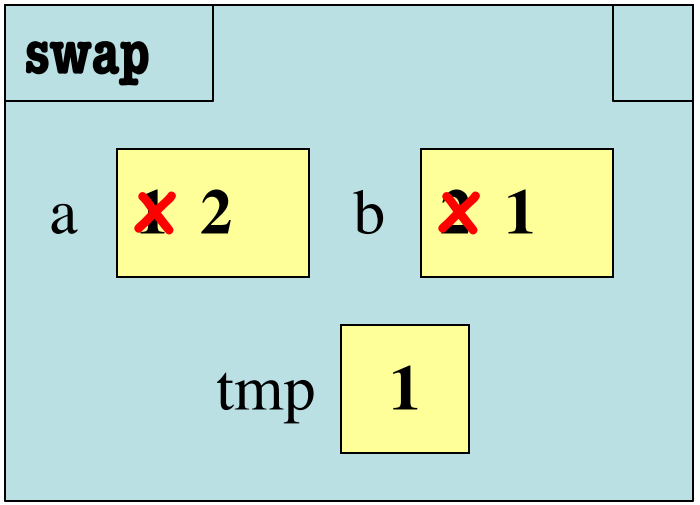

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Global Variables

a **1** b **2**

Call Frame

ERASE THE FRAME

Exercise Time

Function Definition

```
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2     """Return something
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4         Param y: a number"""
5     x = a
6     y = b
7     return x*y+y
```

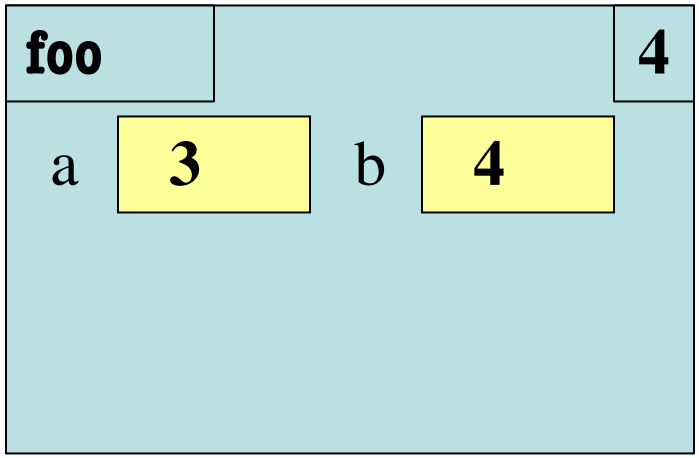
Function Call

```
>>> 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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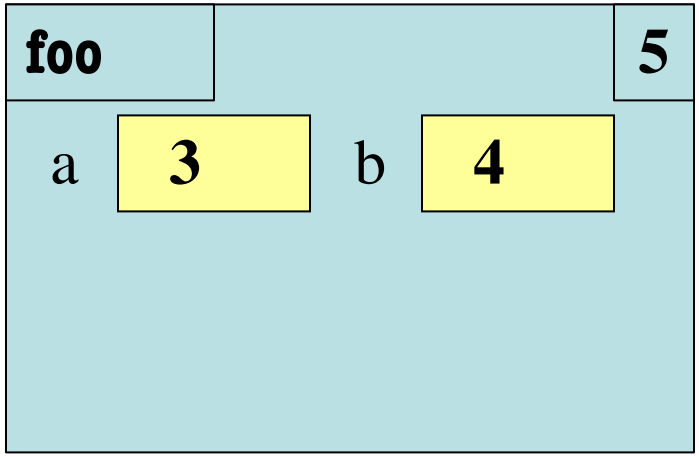

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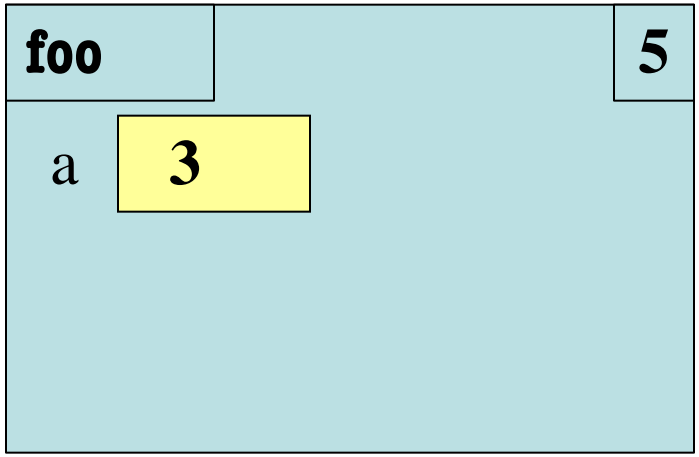

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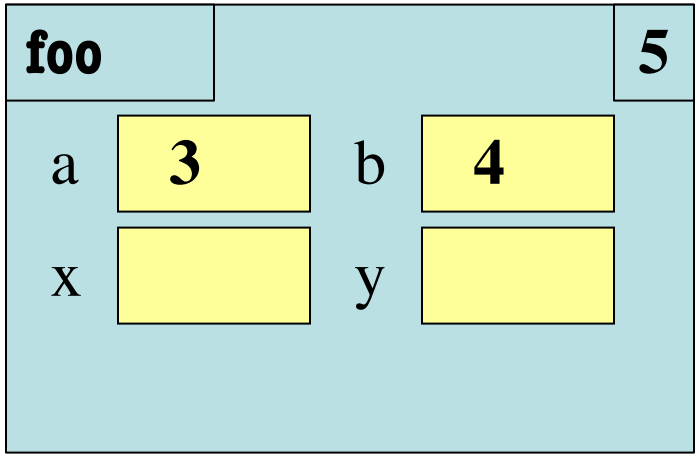

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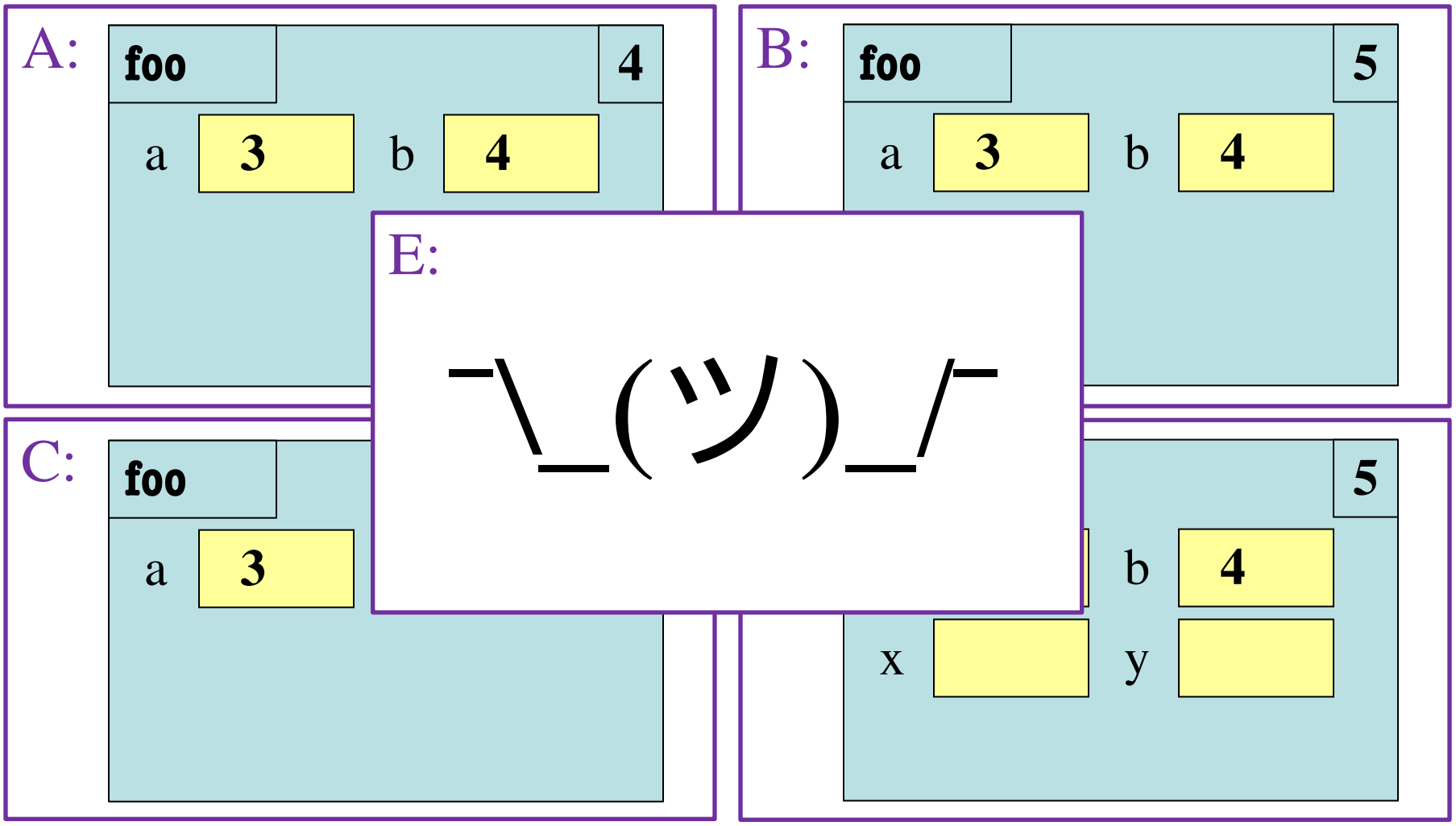

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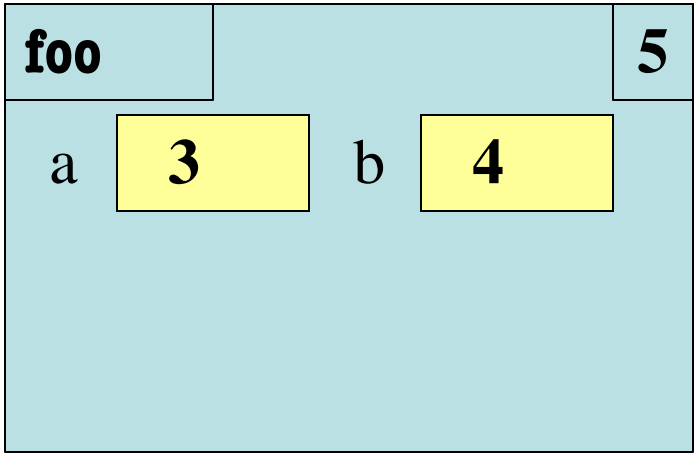

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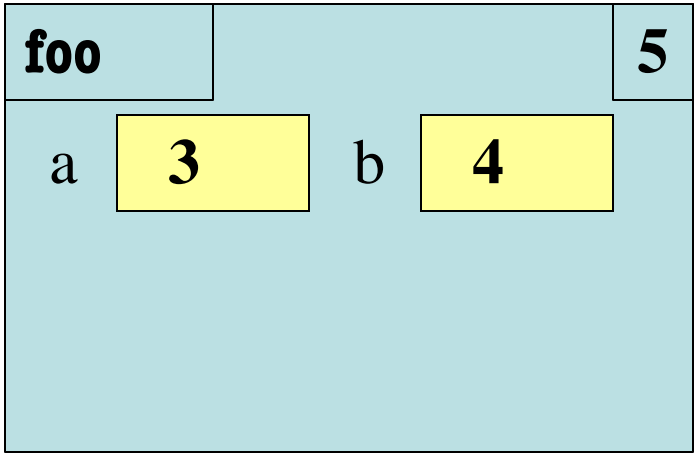

What is the **next step**?

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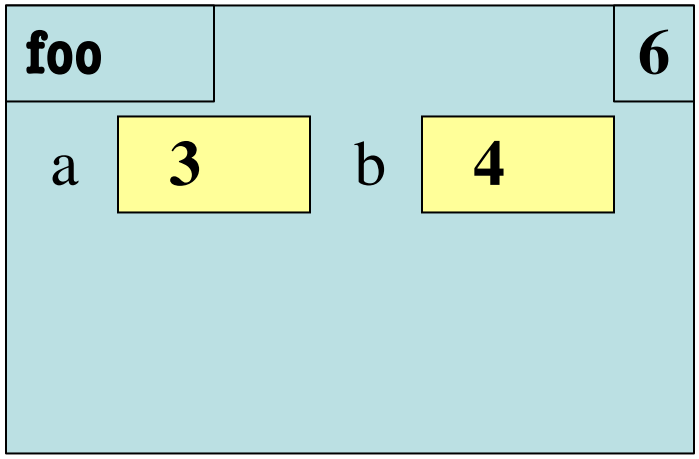

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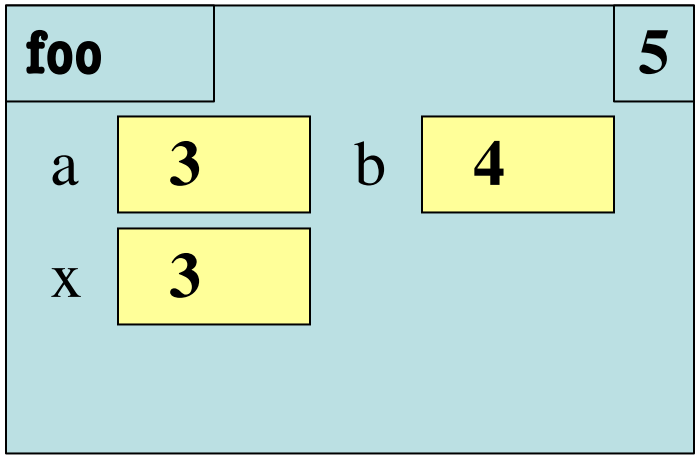

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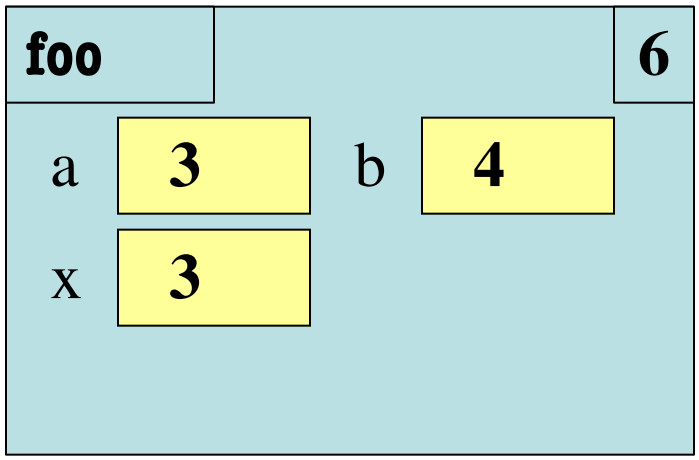

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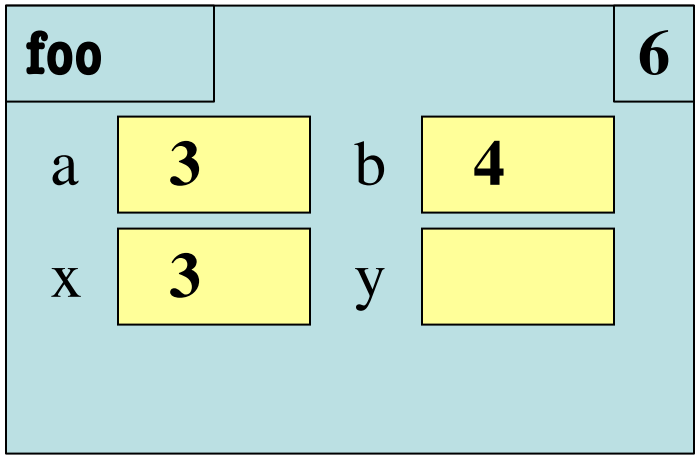

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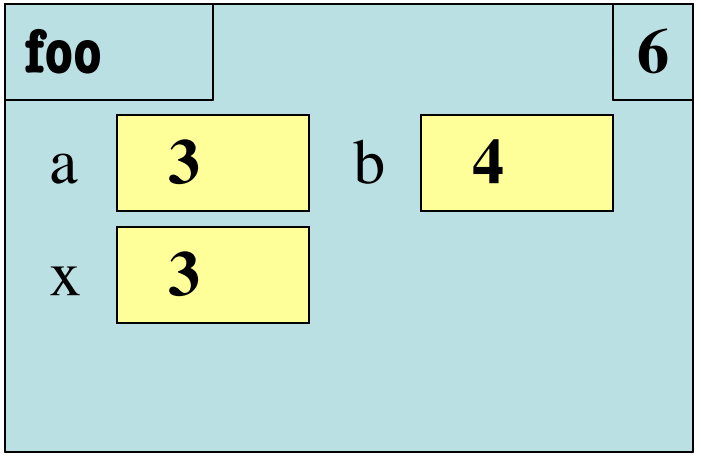

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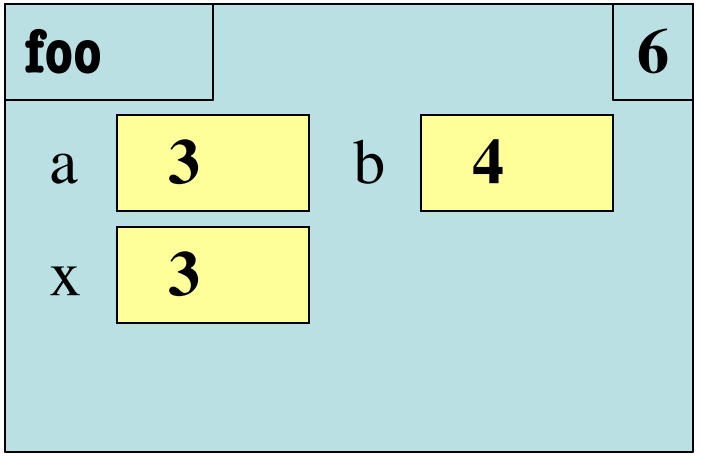

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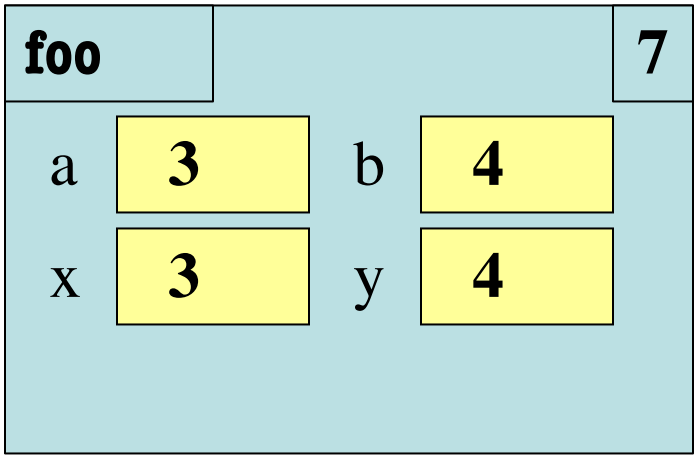

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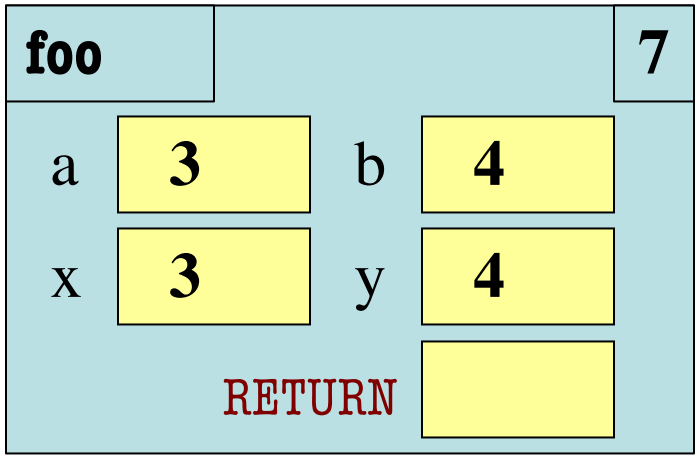

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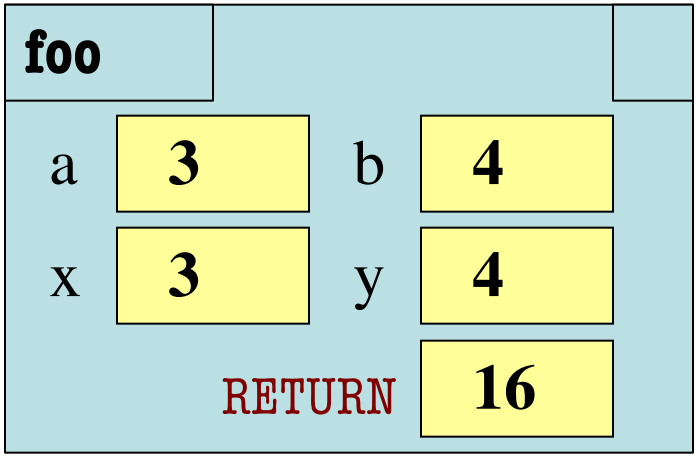

D:

ERASE THE FRAME

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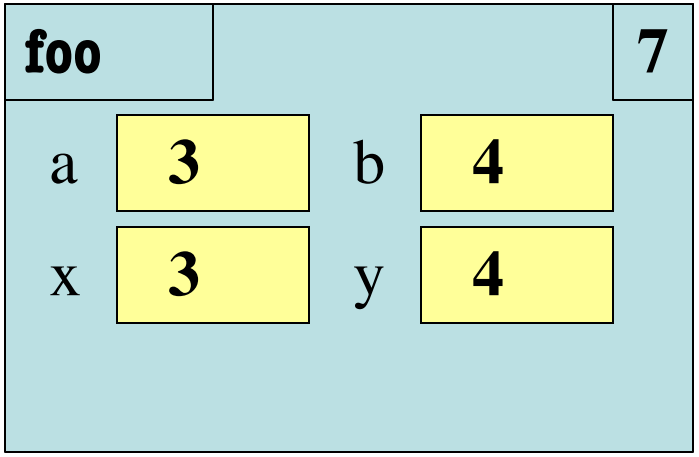

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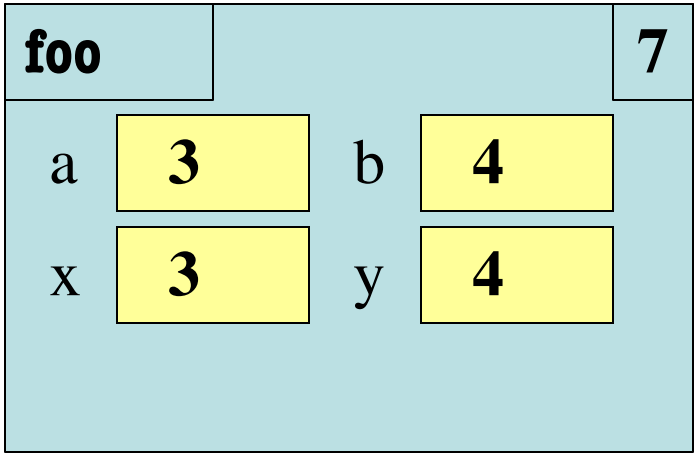

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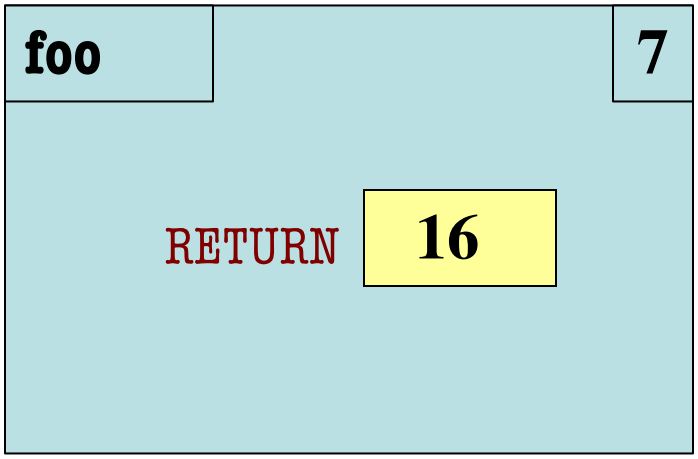

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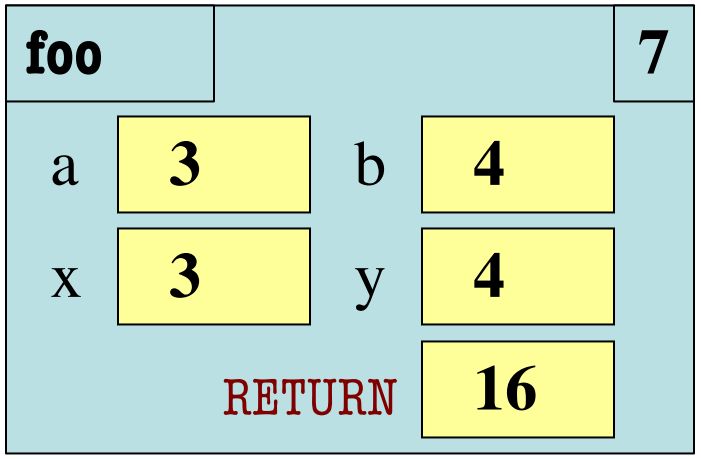

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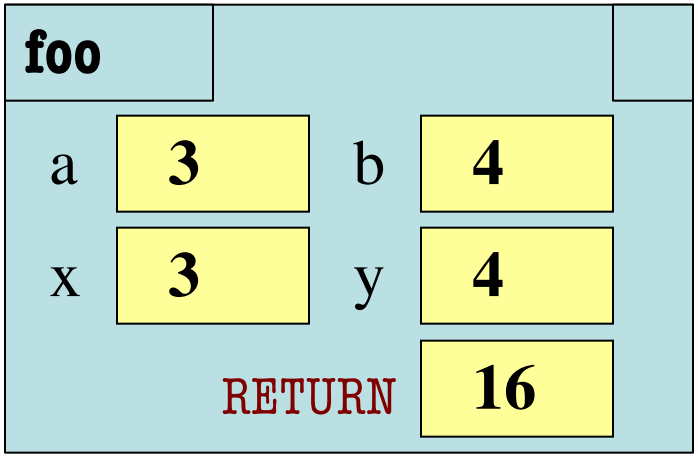

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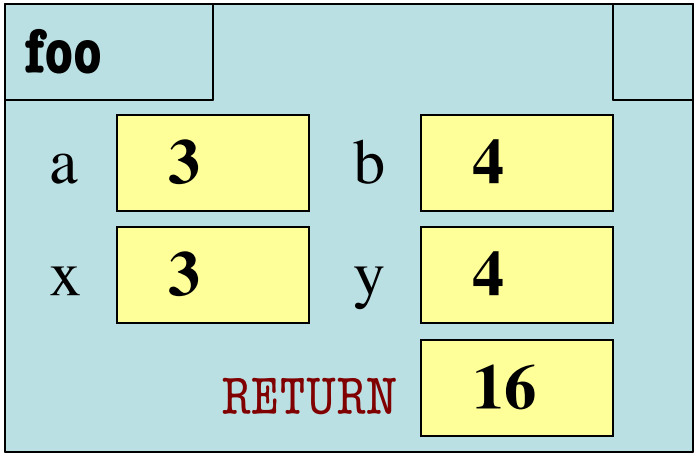
```

C:



Exercise Time

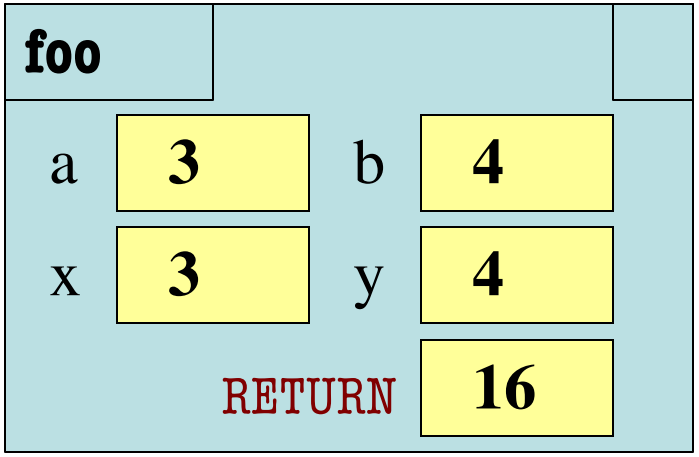
Function Definition

```
1 def foo(a,b):
2     """Return something
3         Param x: a number
4         Param y: a number"""
5     x = a
6     y = b
7     return x*y+y
```

Function Call

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

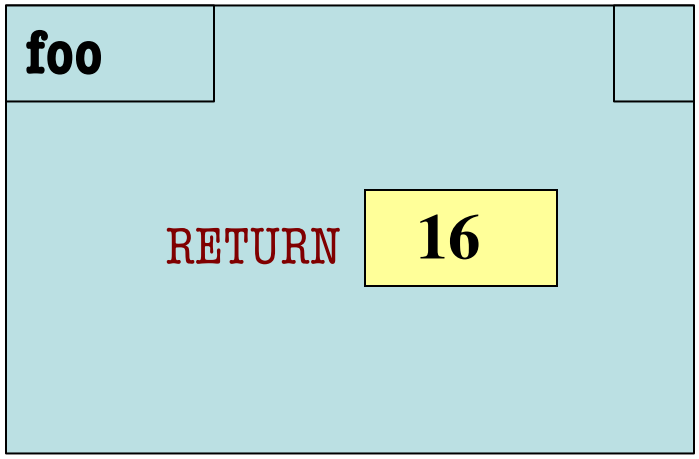
C:



What is the **next step**?

Which One is Closest to Your Answer?

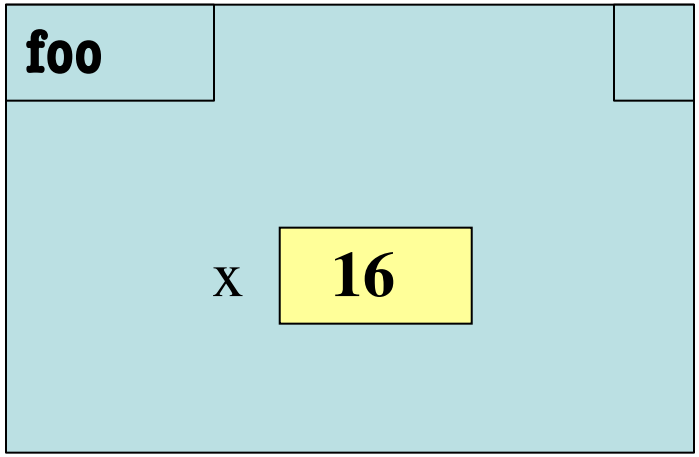
A:



B:

ERASE THE FRAME

C:



D:

x 16

ERASE THE FRAME

Exercise Time

Function Definition

```
1 def foo(a,b):
2     """Return something
3         Param x: a number
4         Param y: a number"""
5     x = a
6     y = b
7     return x*y+y
```

Function Call

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

D:

x **16**

ERASE THE FRAME

Exercise Time

Function Definition

```
1 def foo(a,b):
2     """Return something
3         Param x: a number
4         Param y: a number"""
5     x = a
6     y = b
7     return x*y+y
```

Function Call

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

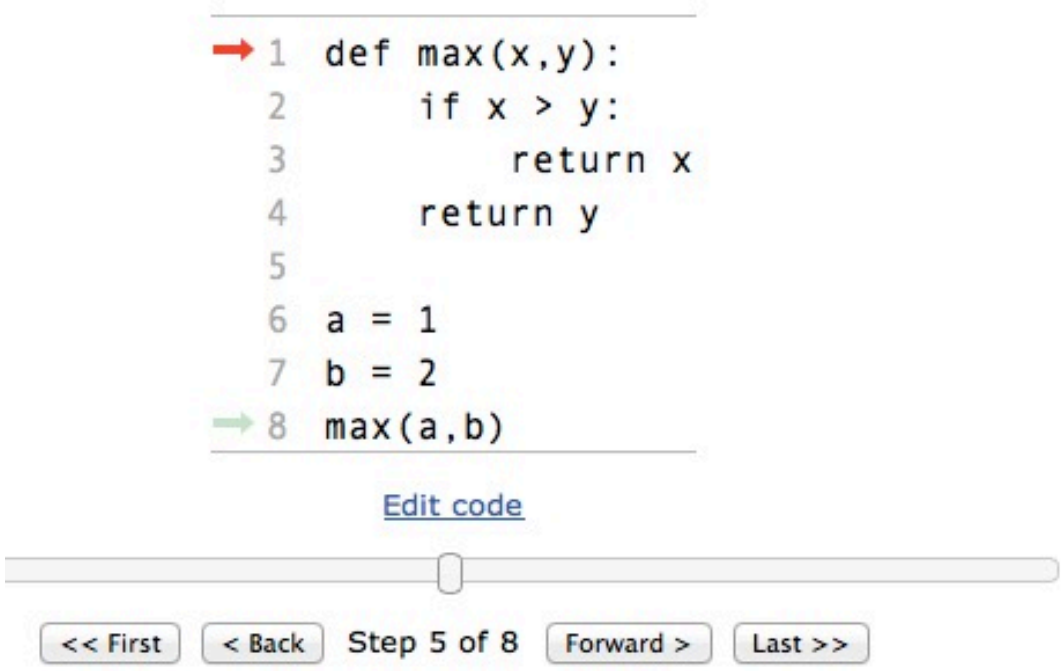
D:

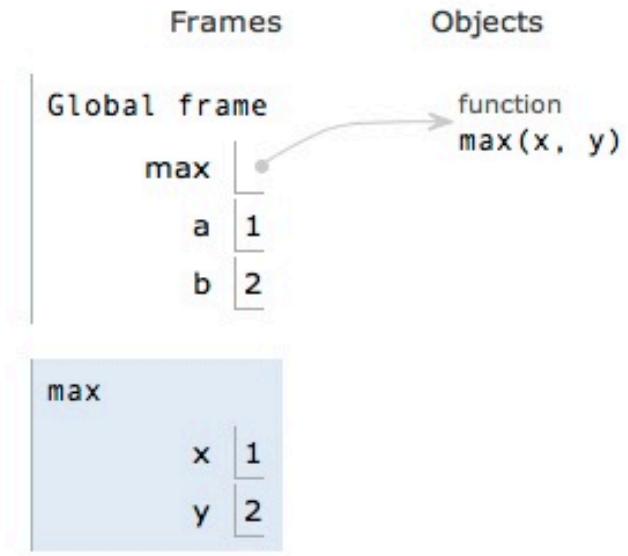
Variable in global space

x **16**

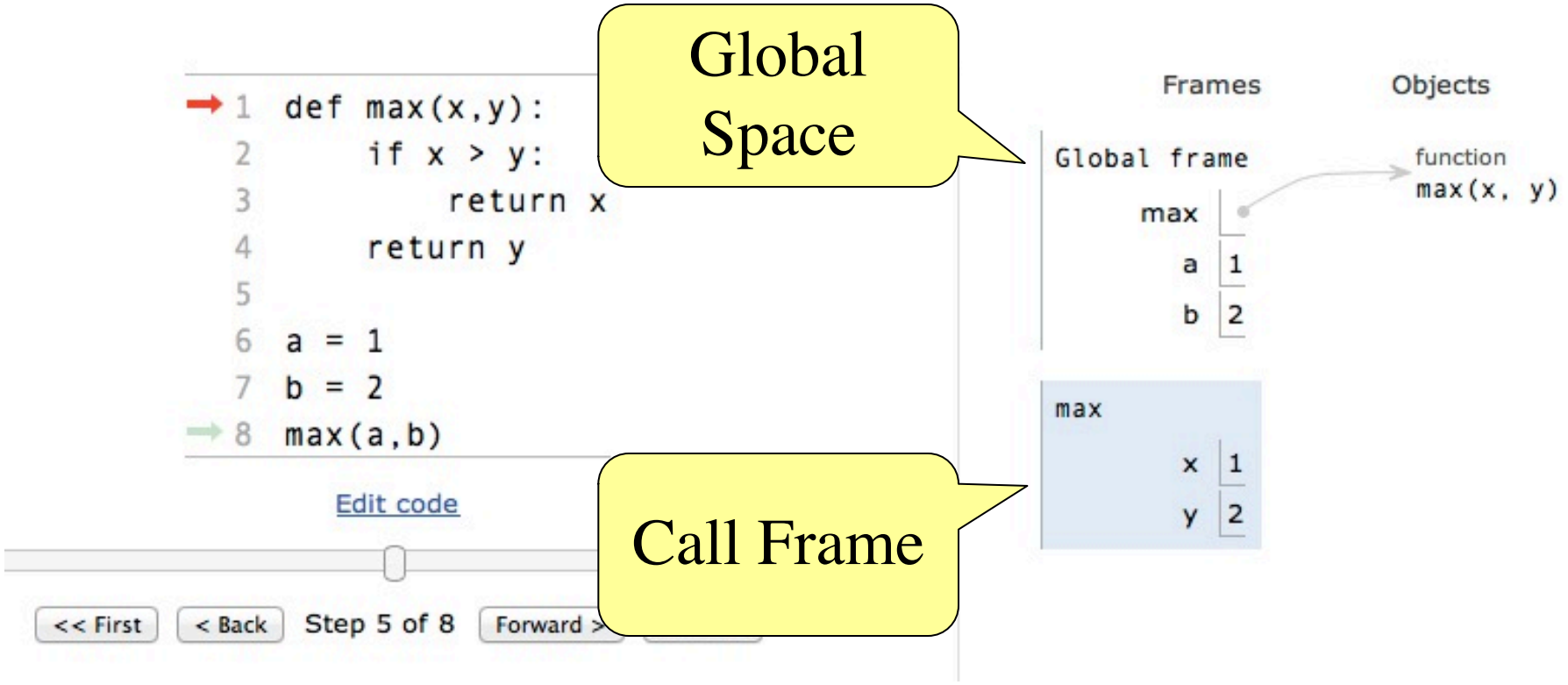
ERASE THE FRAME

Visualizing Frames: The Python Tutor

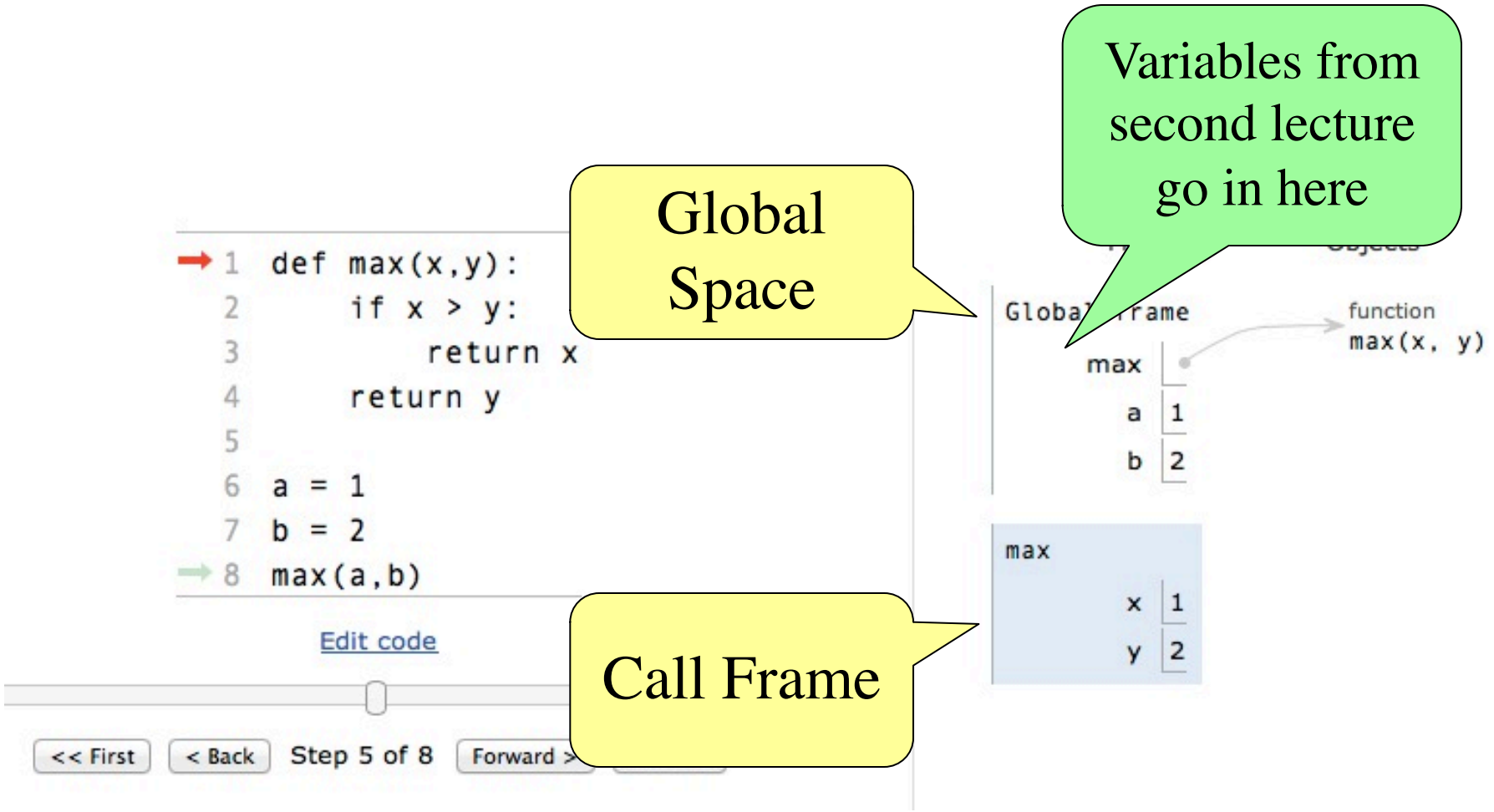




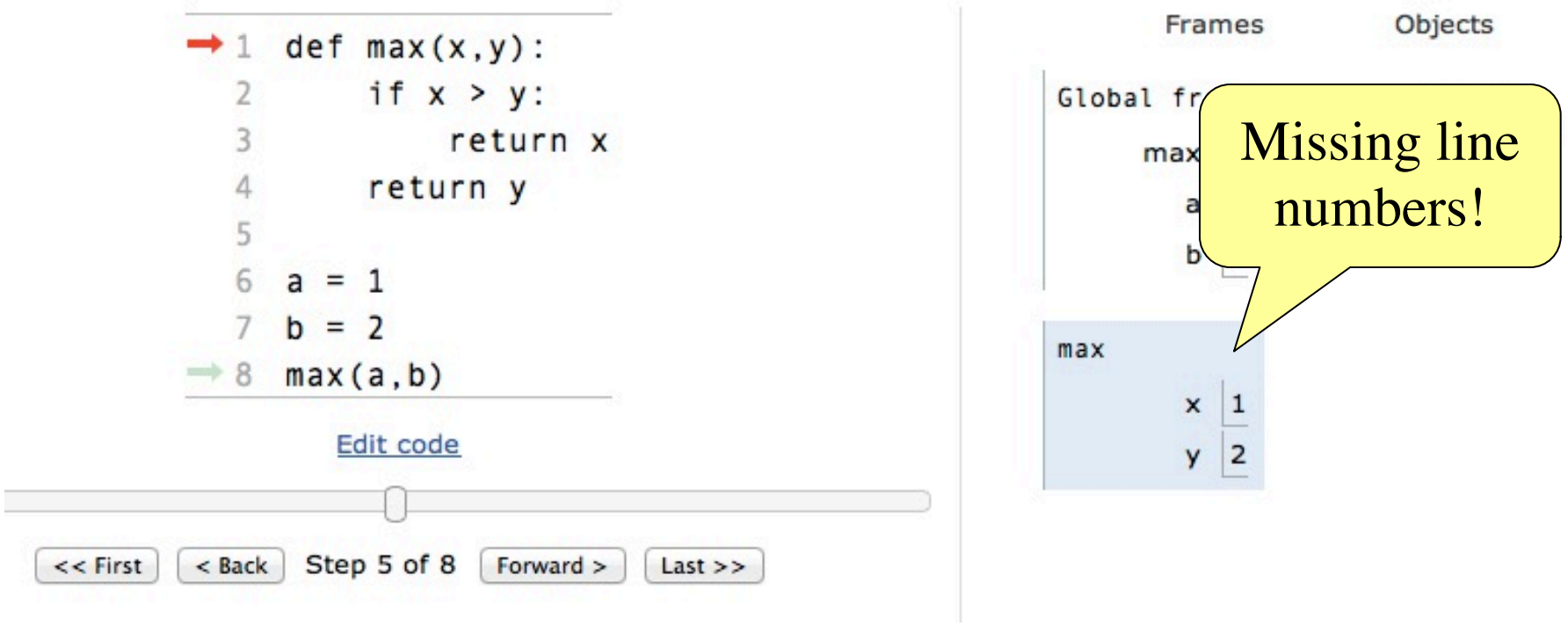
Visualizing Frames: The Python Tutor



Visualizing Frames: The Python Tutor

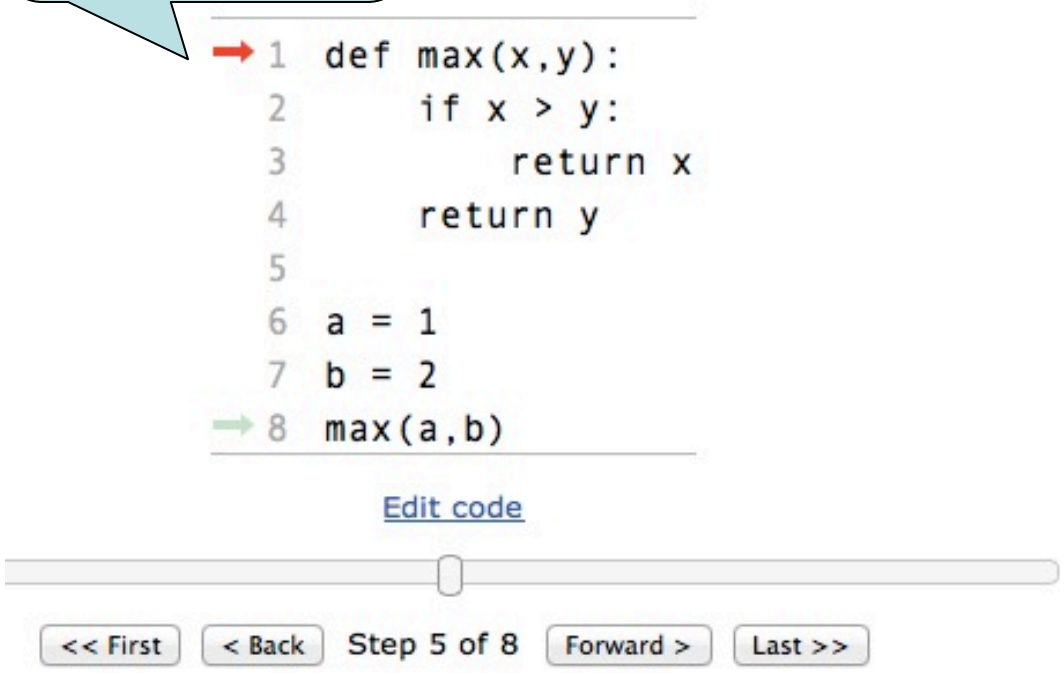


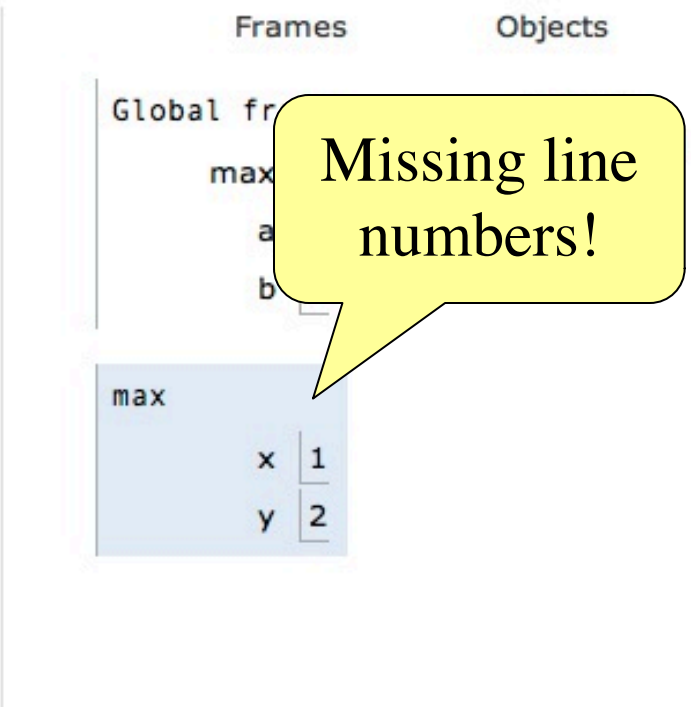
Visualizing Frames: The Python Tutor



Visualizing Frames: The Python Tutor

Line number marked here (sort-of)





Missing line numbers!

Next Time: Text Processing