CS61A Lecture 3

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UC Berkeley
January 28, 2013

Announcements

- Reminder: hw0 due tonight, hw1 due Wed.
- In-class quiz on Friday
  - Covers through Wednesday’s lecture
  - Bring a writing implement
- Hog project out
  - Get started early!
  - More on hog next time

The Elements of Programming

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- Primitive Expressions and Statements
  - The simplest building blocks of a language

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- Primitive Expressions and Statements
  - The simplest building blocks of a language
- Means of Combination
  - Compound elements built from simpler ones
- Means of Abstraction
  - Elements can be named and manipulated as units

Environment Diagrams

Environment diagrams visualize the interpreter's process.

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1  from math import pi
2  tau = 2 * pi
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Global frame	
pi	3.1416

Example: http://goo.gl/SK13i

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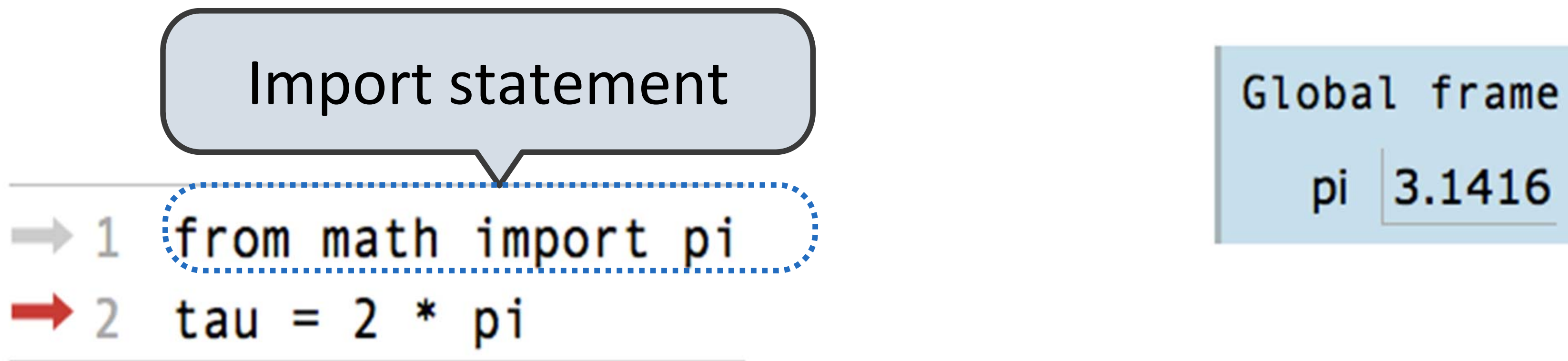

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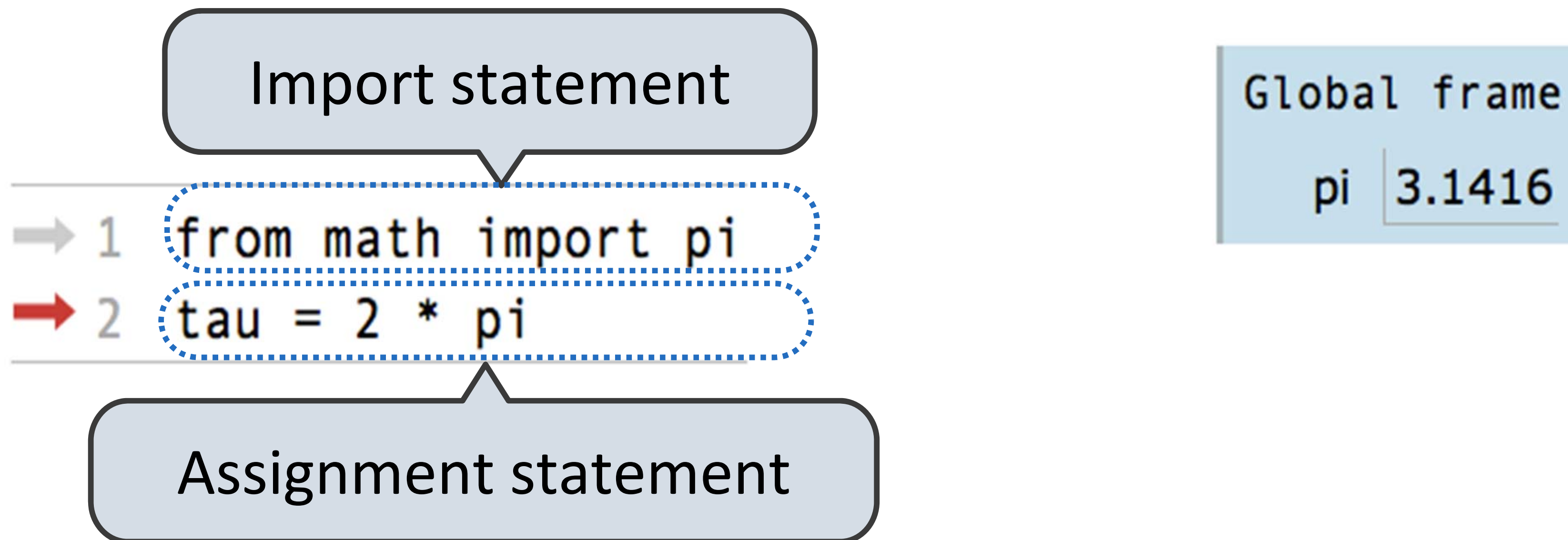

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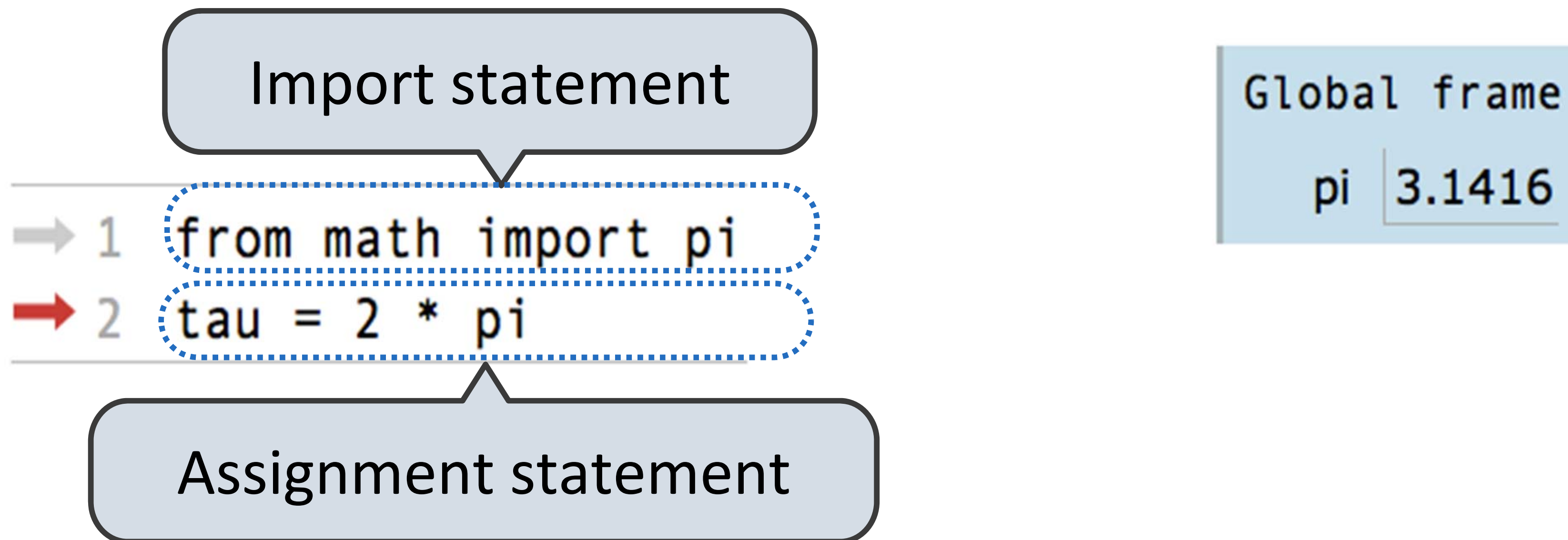

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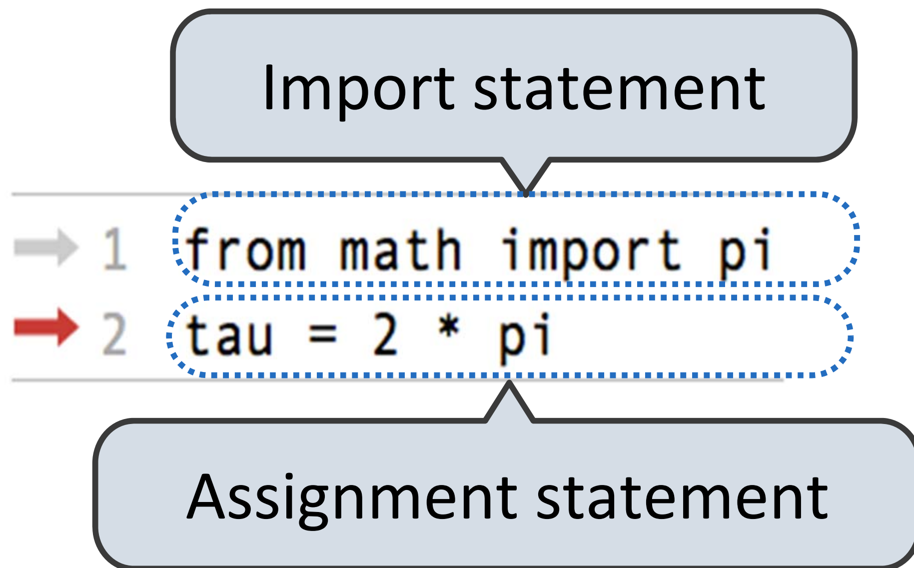

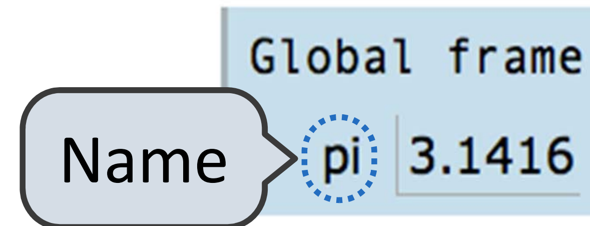

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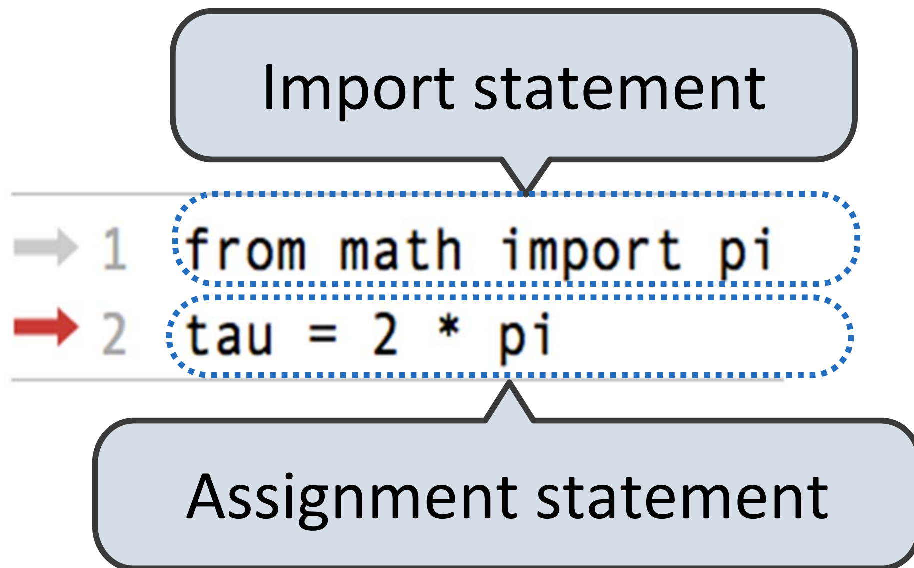

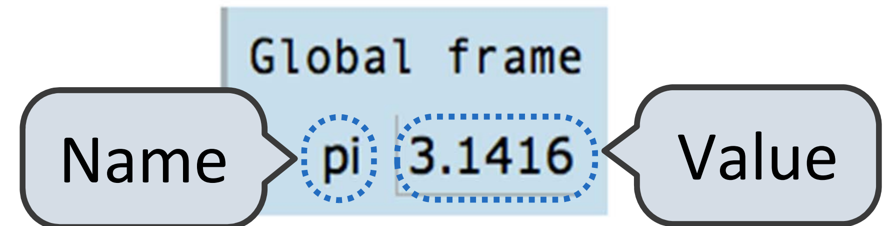

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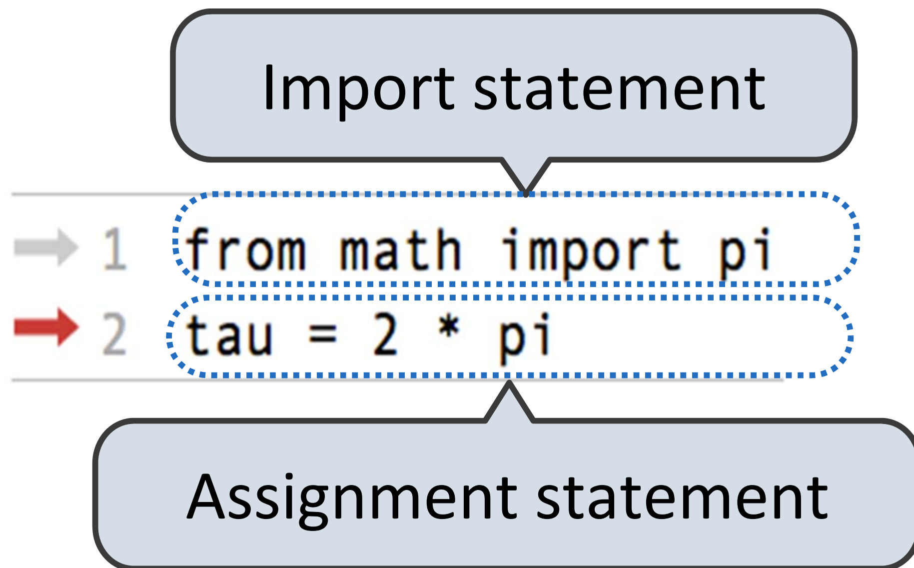

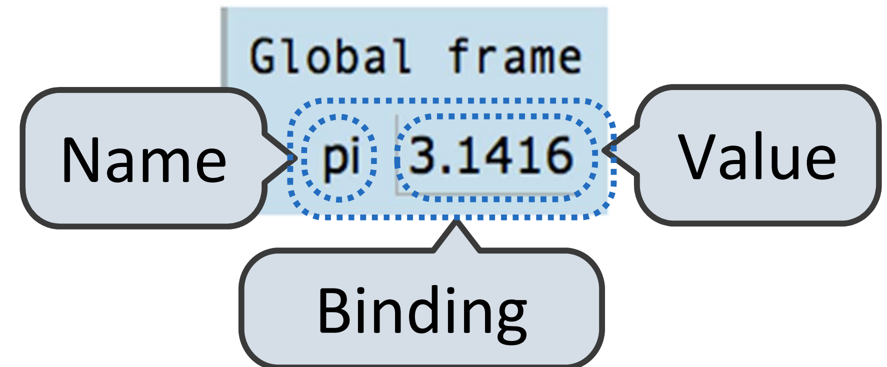

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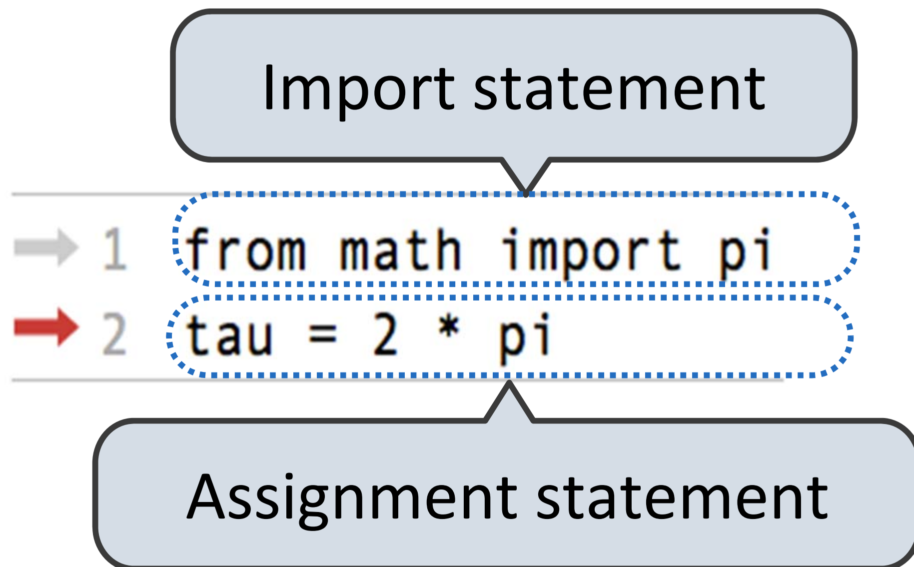

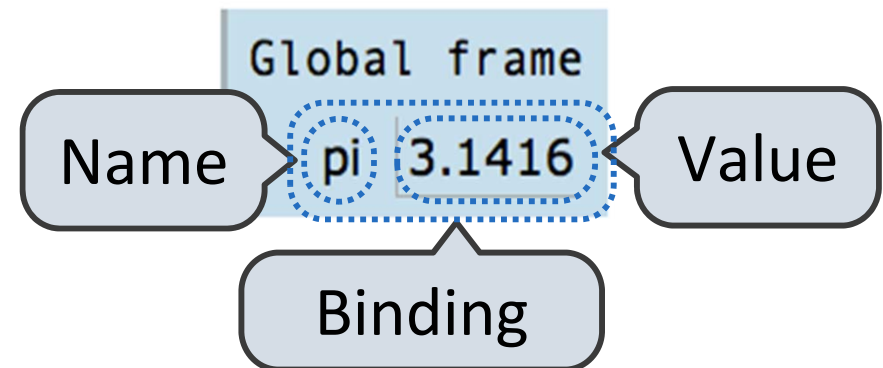

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In a frame, there is at most one binding per name

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Named computational processes are a more powerful means of abstraction

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>>> def  <name>(<formal parameters>):
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Execution procedure for def statements:

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Calling User-Defined Functions

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2  def square(x):
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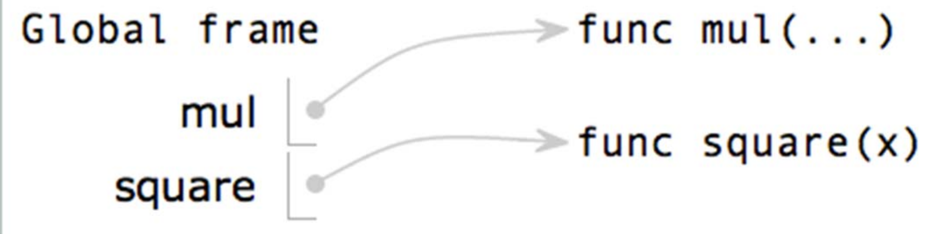

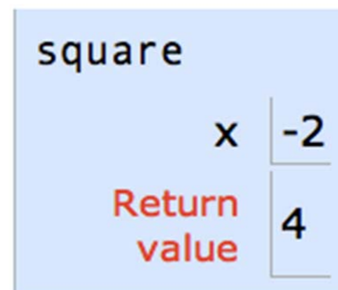

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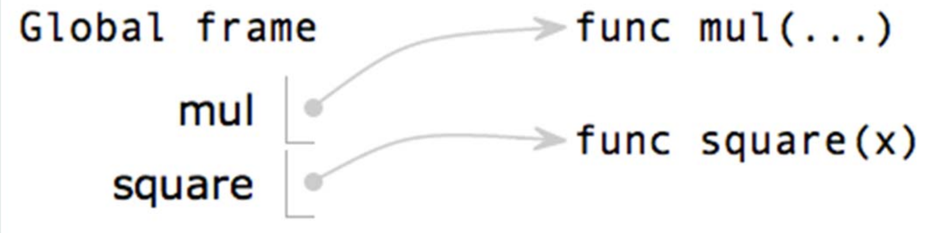

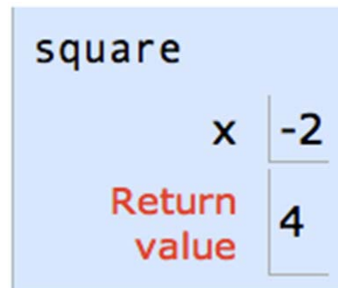

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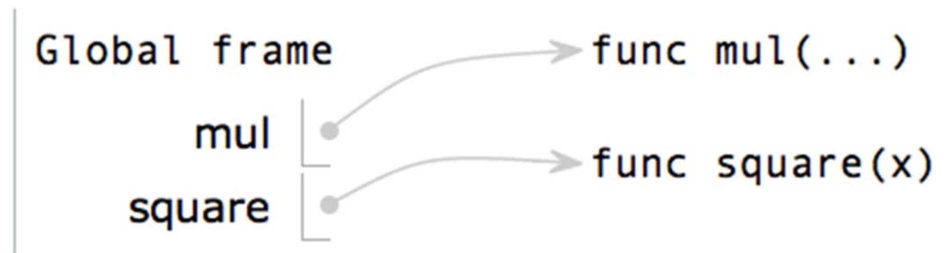

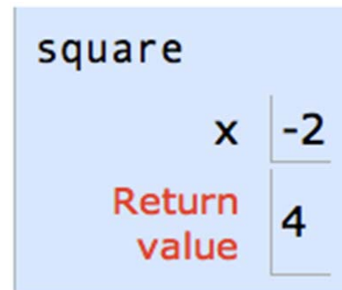

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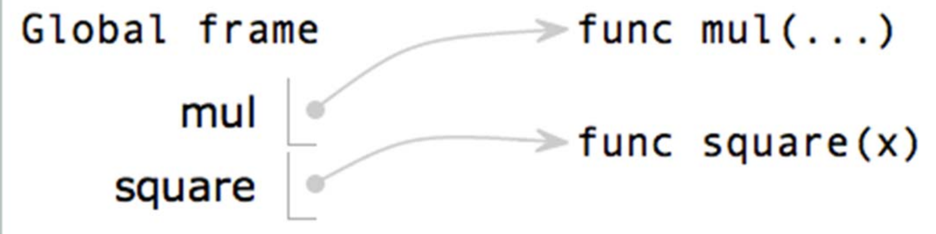

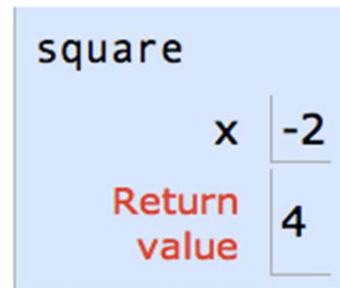

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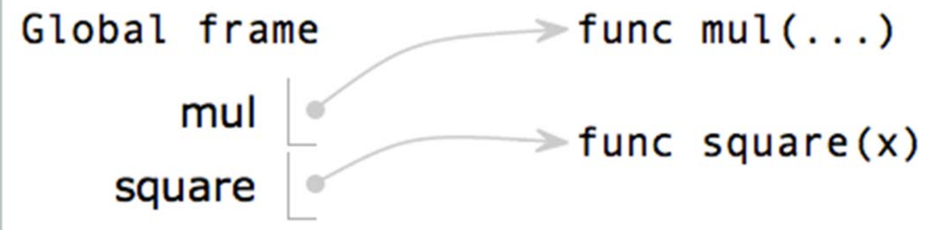

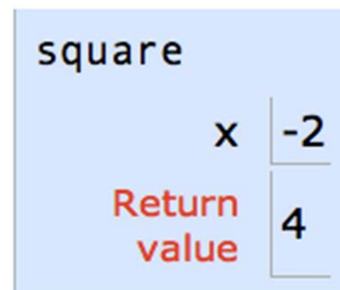

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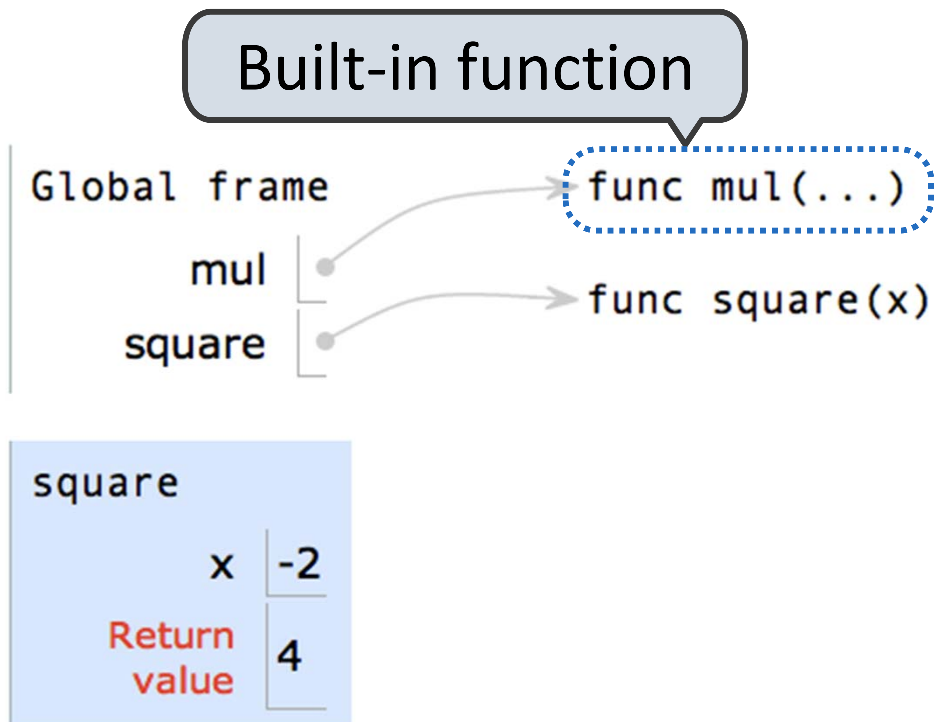

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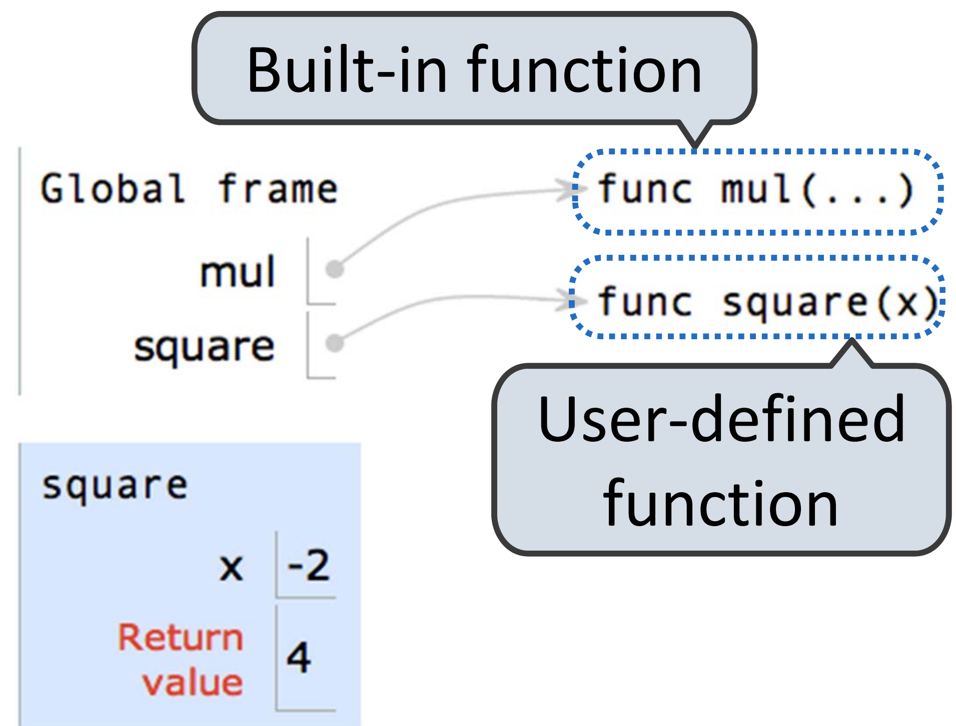

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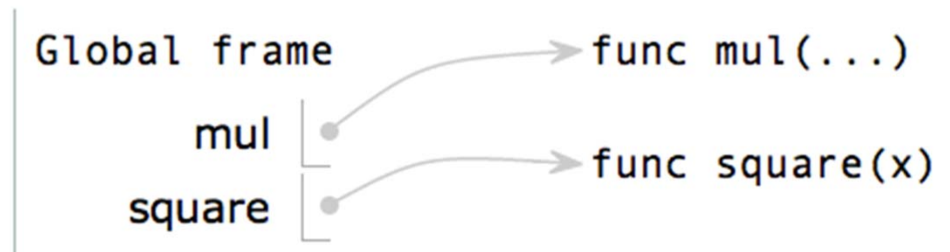

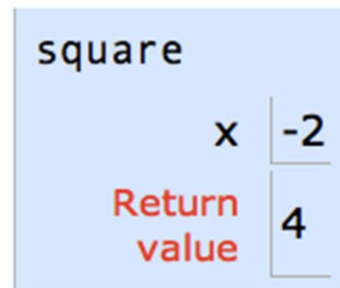

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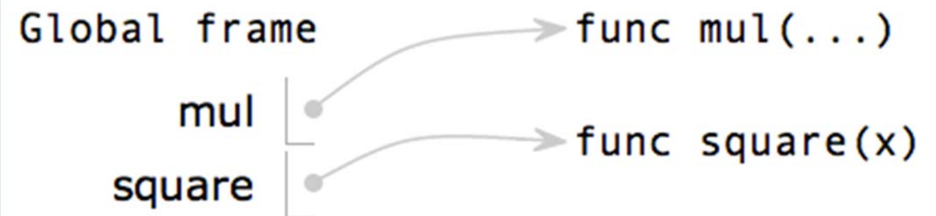
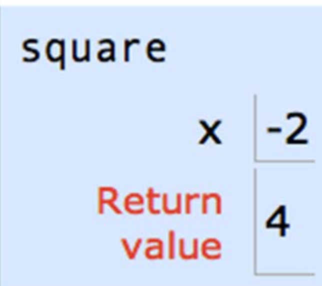


A function's signature has all the information to create a local frame



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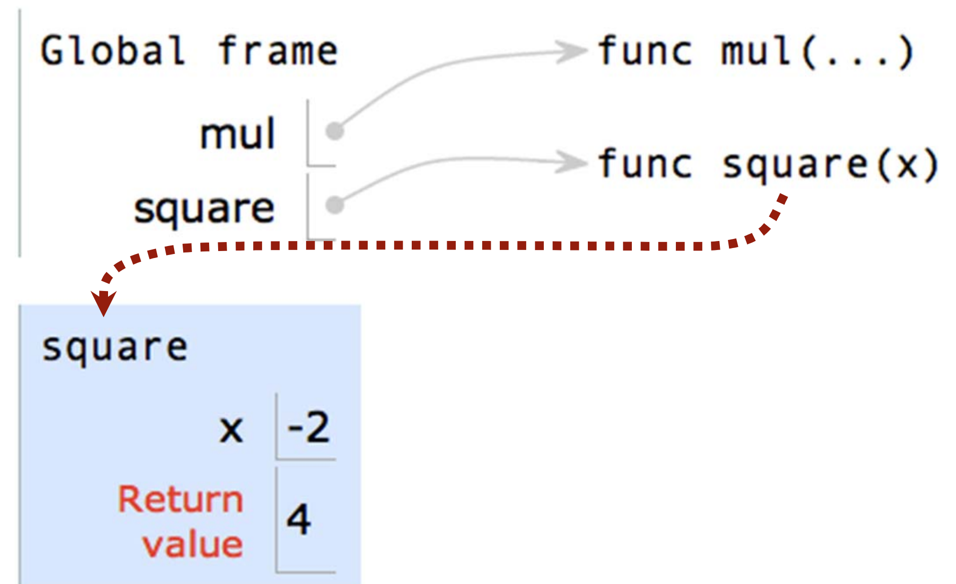

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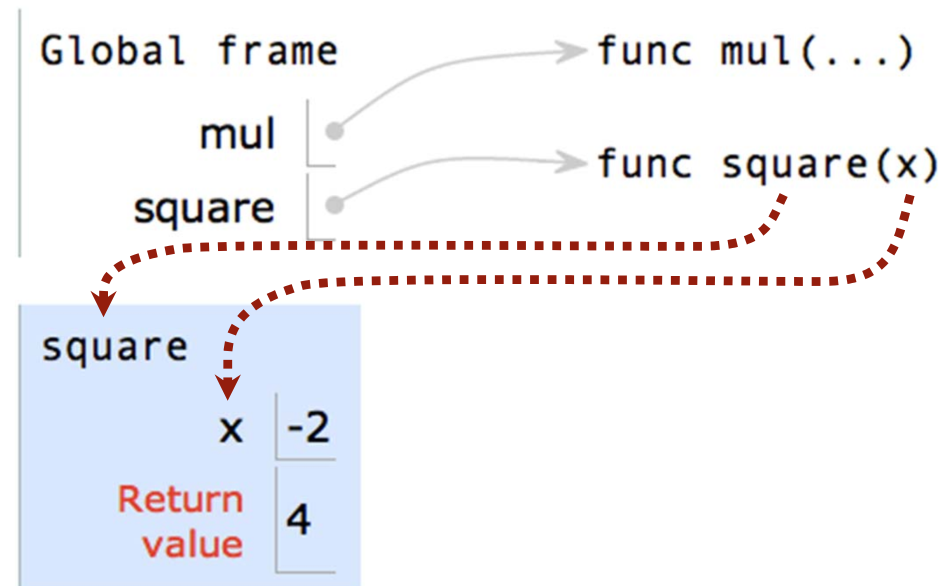

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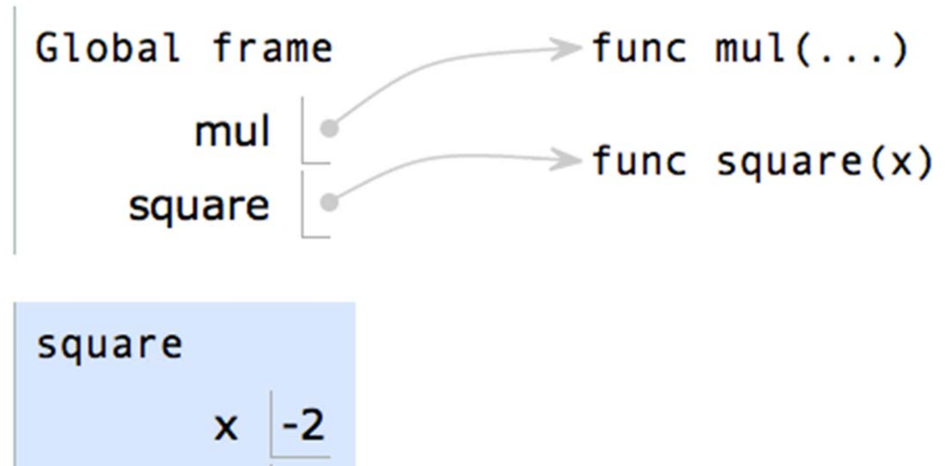

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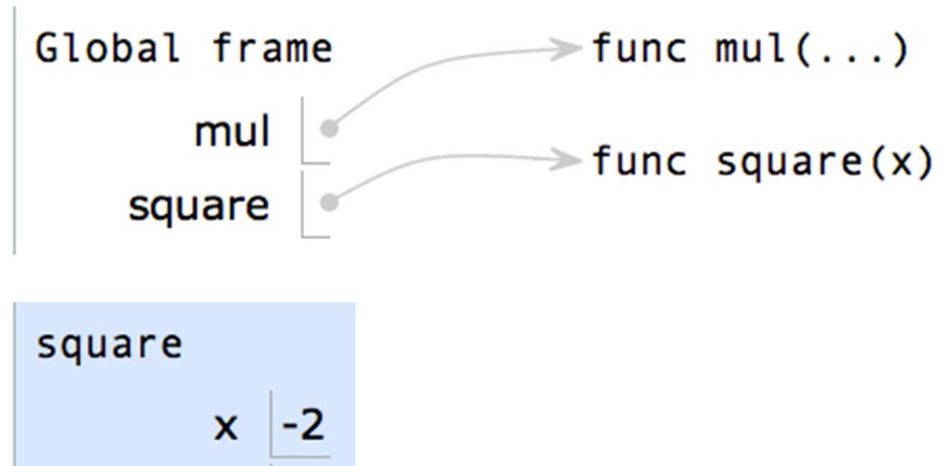

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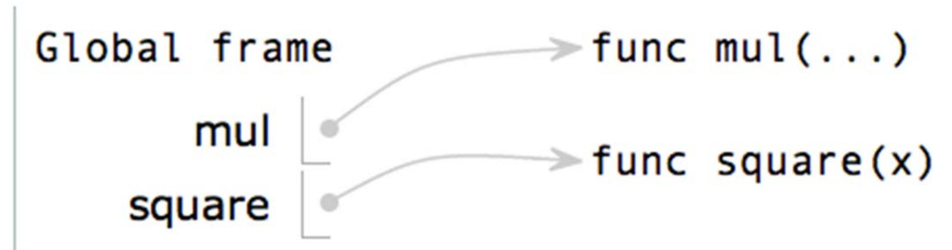

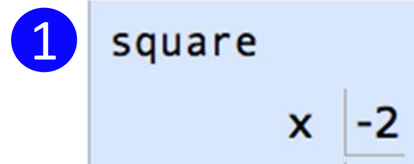

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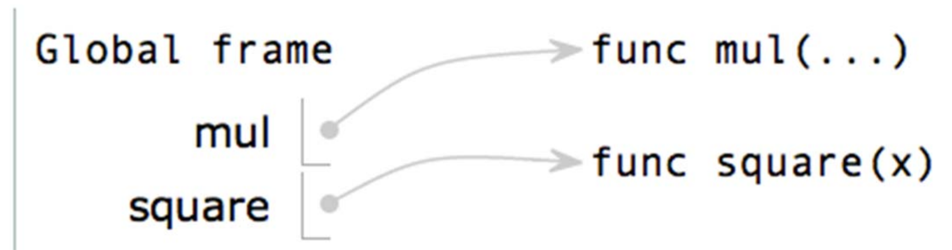

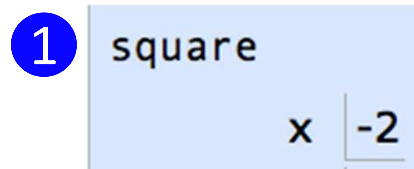

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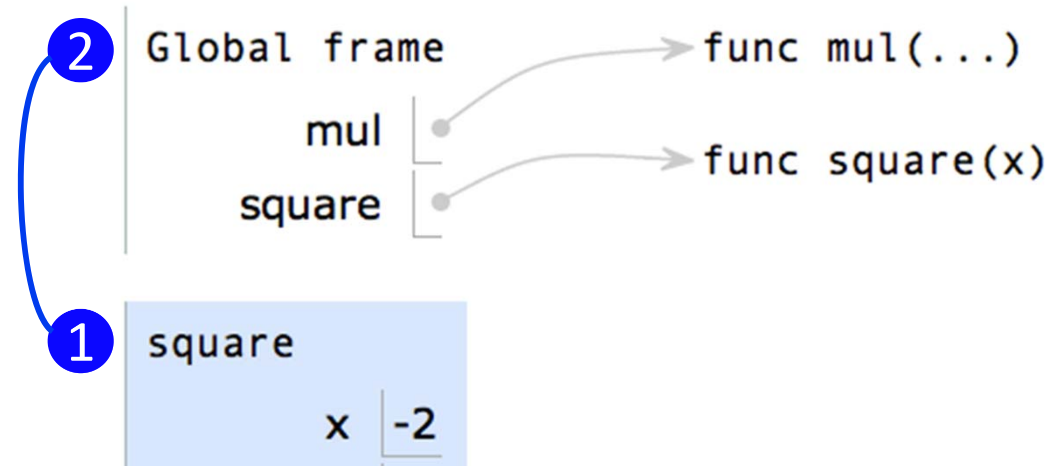

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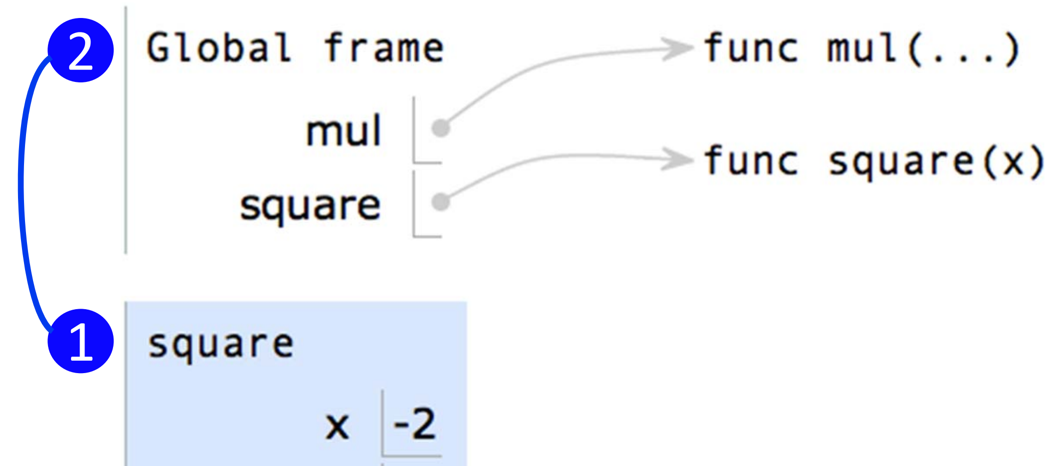

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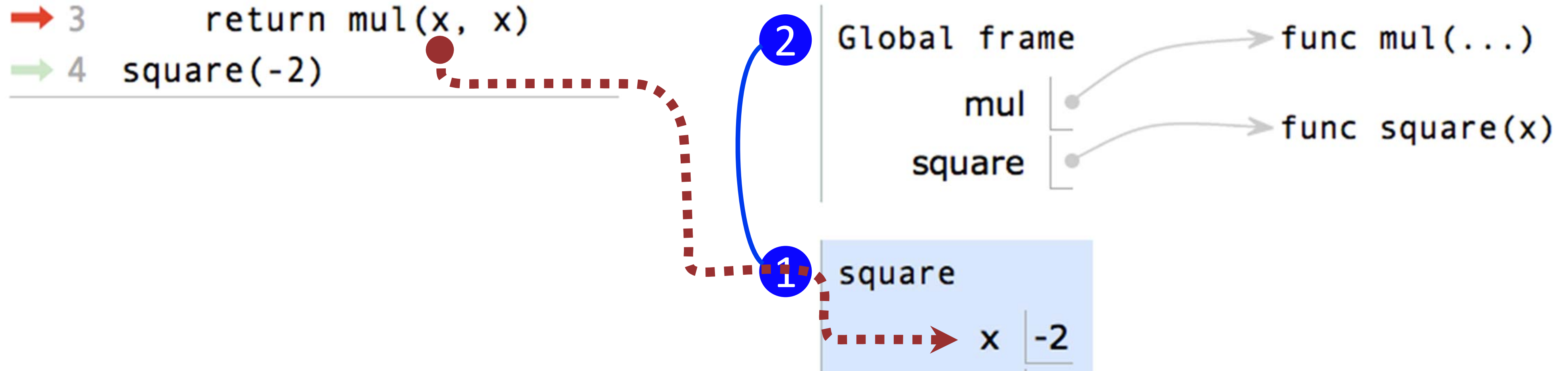

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- **Important properties of environments:**

General Lookup Procedure

- Every expression is evaluated in the context of an environment
- So far, the current environment is either:
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- **Important properties of environments:**
  - An environment is a sequence of frames

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  - The earliest frame that contains a binding for a name determines the value that the name evaluates to

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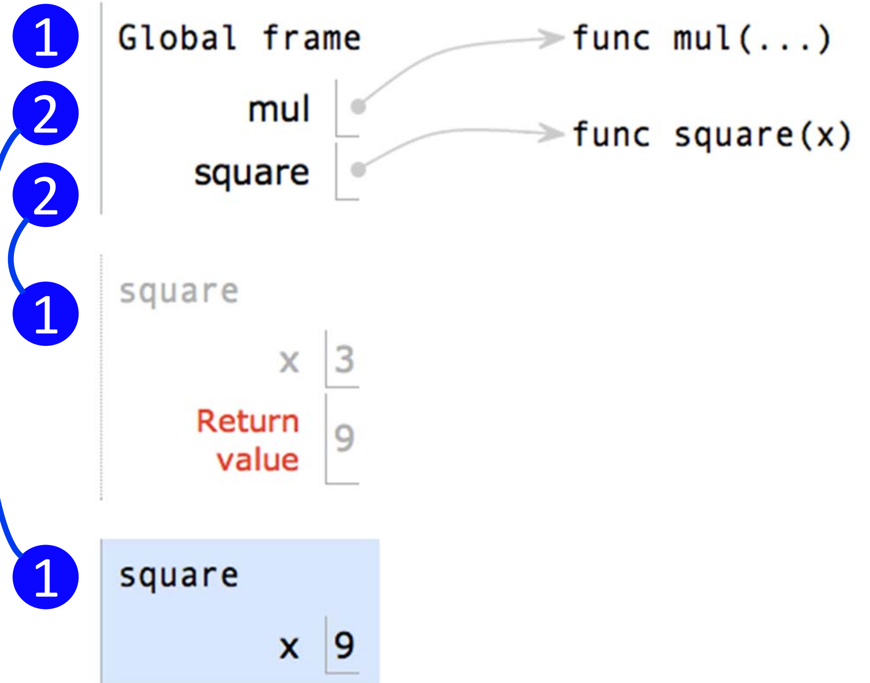
- **Important properties of environments:**
  - An environment is a sequence of frames
  - The earliest frame that contains a binding for a name determines the value that the name evaluates to
- The *scope* of a name is the region of code that has access to it

Multiple Environments in a Diagram

```
1  from operator import mul
2  def square(x):
3      return mul(x, x)
4  square(square(3))
```



Example: http://goo.gl/hrfnV

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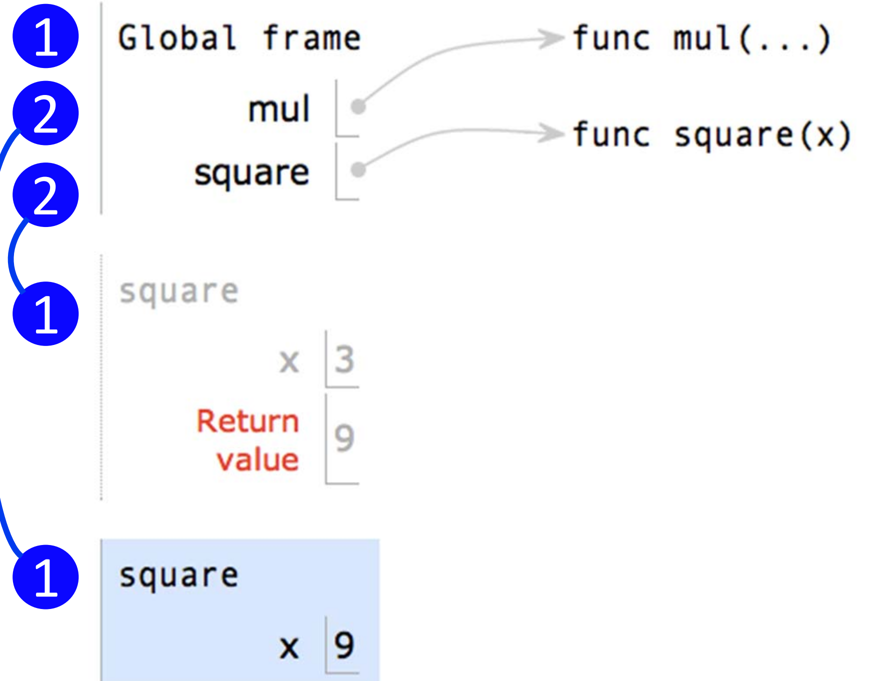

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Multiple Environments in a Diagram

Every expression is evaluated in the context of an environment.

The earliest frame that contains a binding for a name determines the value that the name evaluates to.

```
1  from operator import mul
2  def square(x):
3      return mul(x, x)
4  square(square(3))
```

Global frame
mul → func mul(...)
square → func square(x)

square
x 3
Return value 9

square
x 9

Example: http://goo.gl/hrfnV

Multiple Environments in a Diagram

Every expression is evaluated in the context of an environment.

The earliest frame that contains a binding for a name determines the value that the name evaluates to.

mul(x, x)

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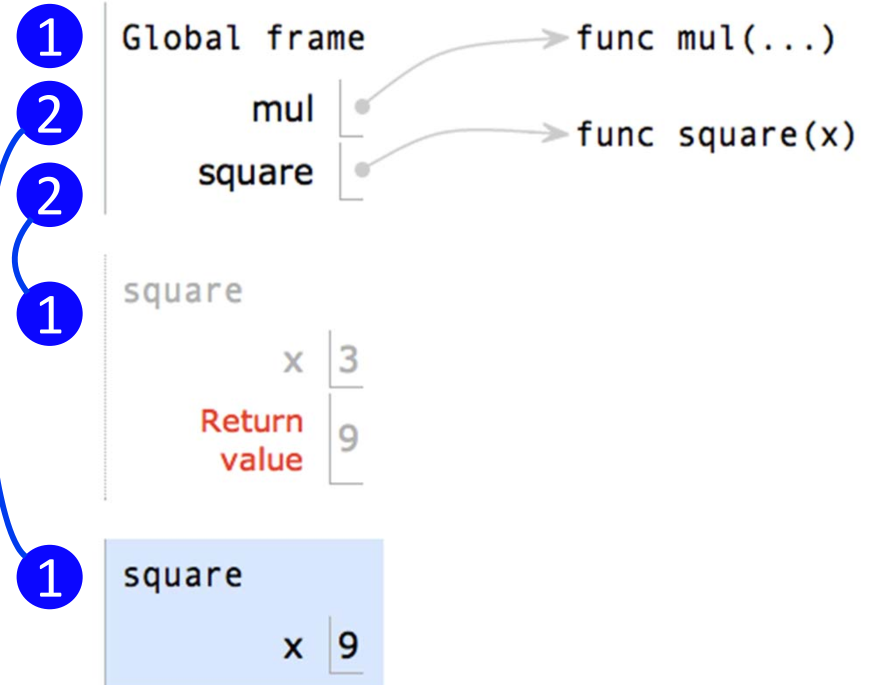

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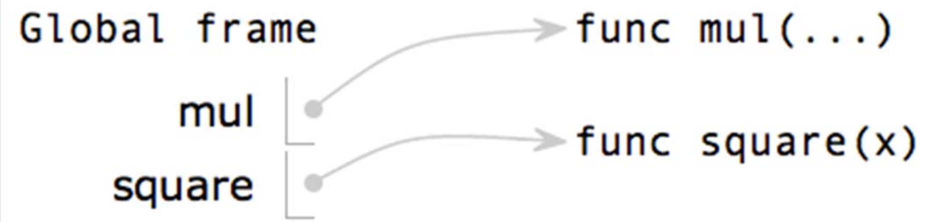
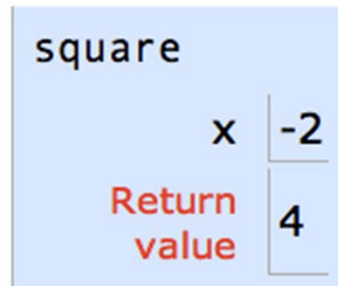
Example: http://goo.gl/hrfnV

Formal Parameters

```
1 from operator import mul
2 def square(x):
3     return mul(x, x)
4 square(-2)
```





Example: http://goo.gl/boCk0

Formal Parameters

```
def square(x):
    return mul(x, x)
```

```
1  from operator import mul
2  def square(x):
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```

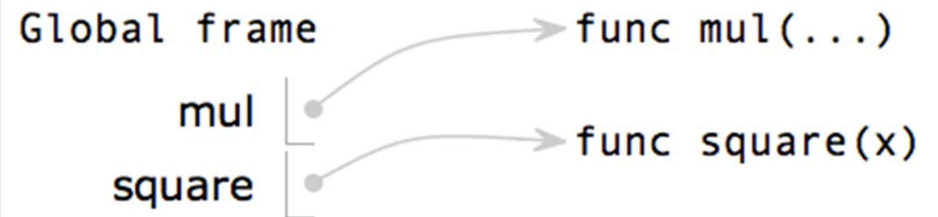

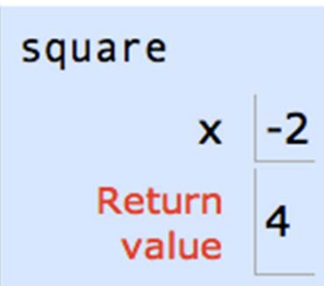

Example: http://goo.gl/boCk0

Formal Parameters

def square(x):
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vs

```
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```
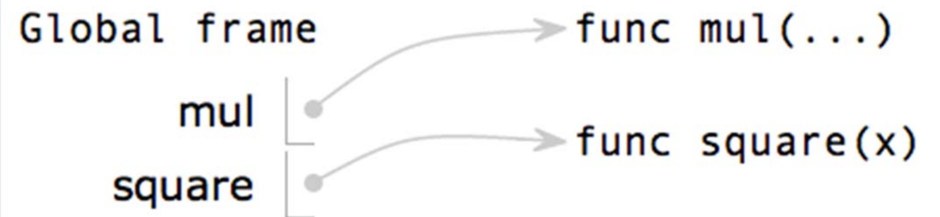
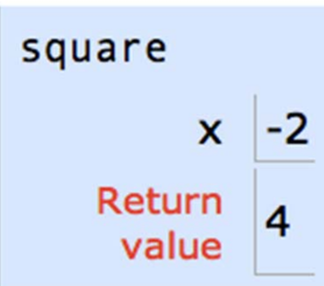





Example: http://goo.gl/boCk0

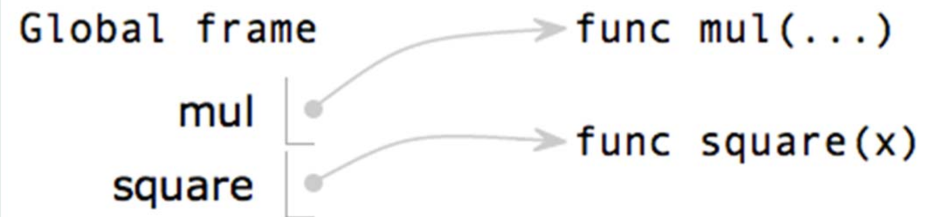
Formal Parameters

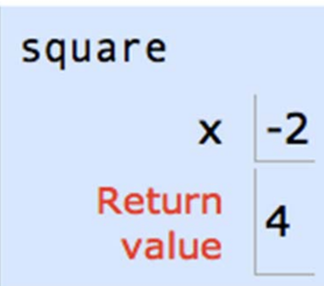
```
def square(x):
    return mul(x, x)
```

vs

```
def square(y):
    return mul(y, y)
```

```
1  from operator import mul
2  def square(x):
3      return mul(x, x)
4  square(-2)
```





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Formal Parameters

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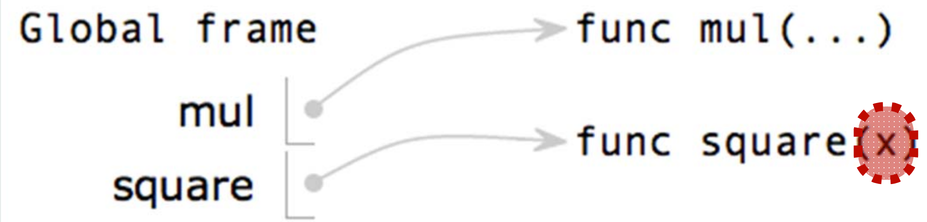

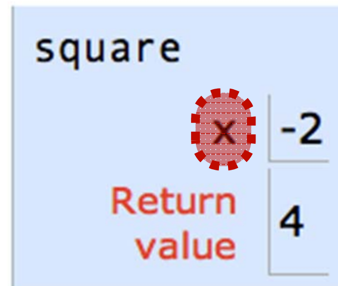

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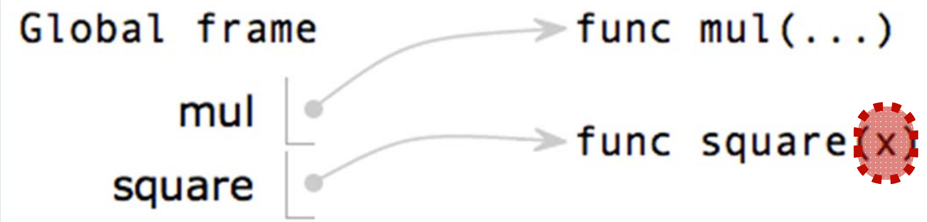
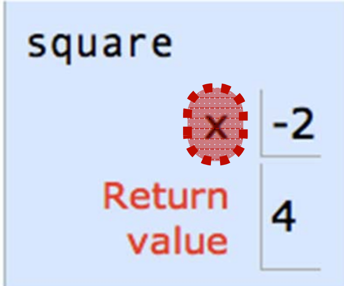




Formal parameters have local scope

Example: http://goo.gl/boCk0

Life Cycle of a User-Defined Function

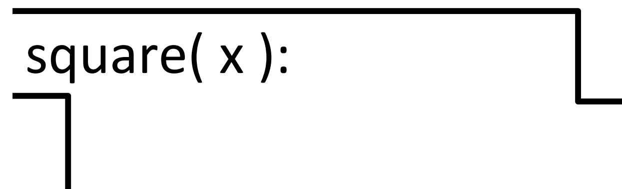
What happens?

Def statement:

```
>>> def    square( x ):
               return mul(x, x)
```

Call expression: square(2+2)

Calling/Applying:



Life Cycle of a User-Defined Function

What happens?

Def statement:

```
>>> def     square( x ):
                return mul(x, x)
```

Def statement

Call expression: square(2+2)

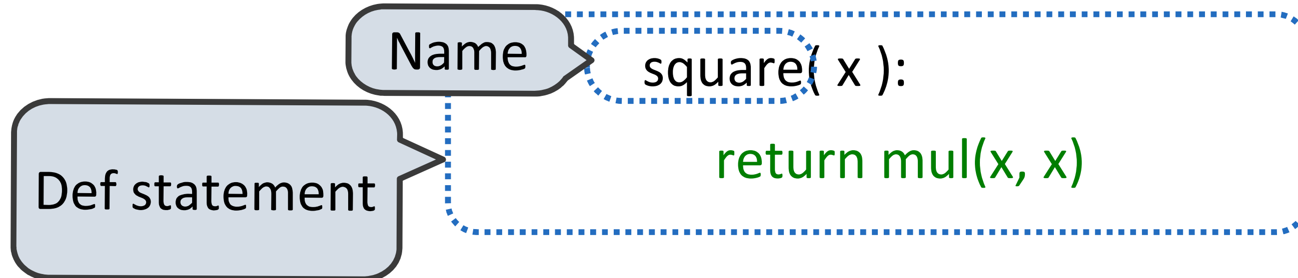
Calling/Applying:

square(x):

Life Cycle of a User-Defined Function

Def statement:

What happens?



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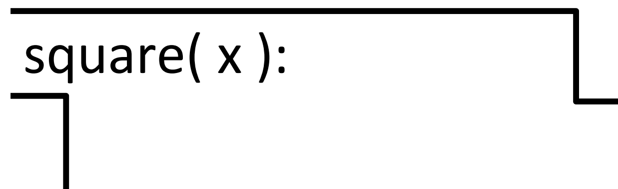
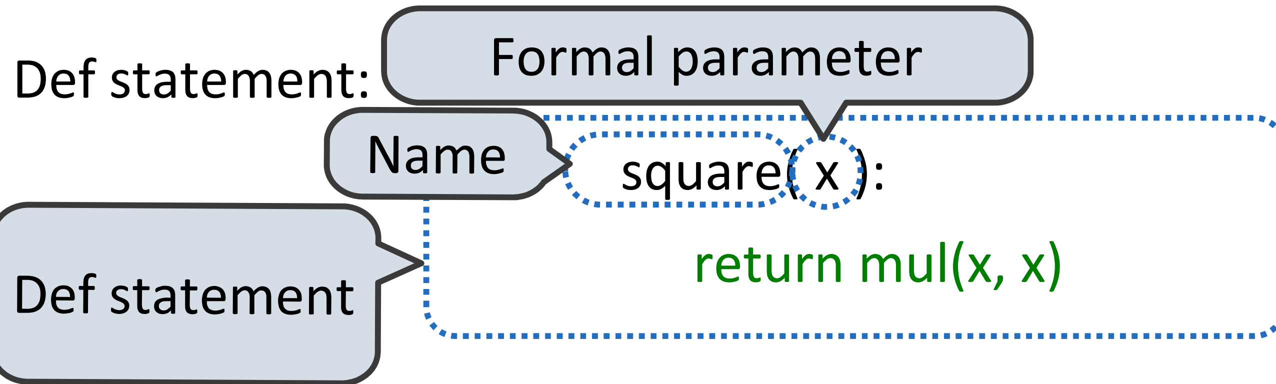


Life Cycle of a User-Defined Function

Def statement:

What happens?



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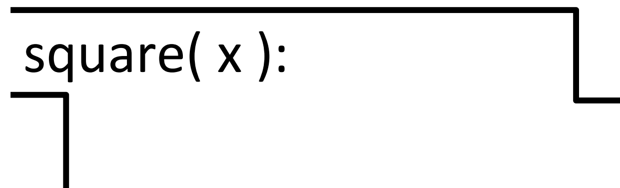

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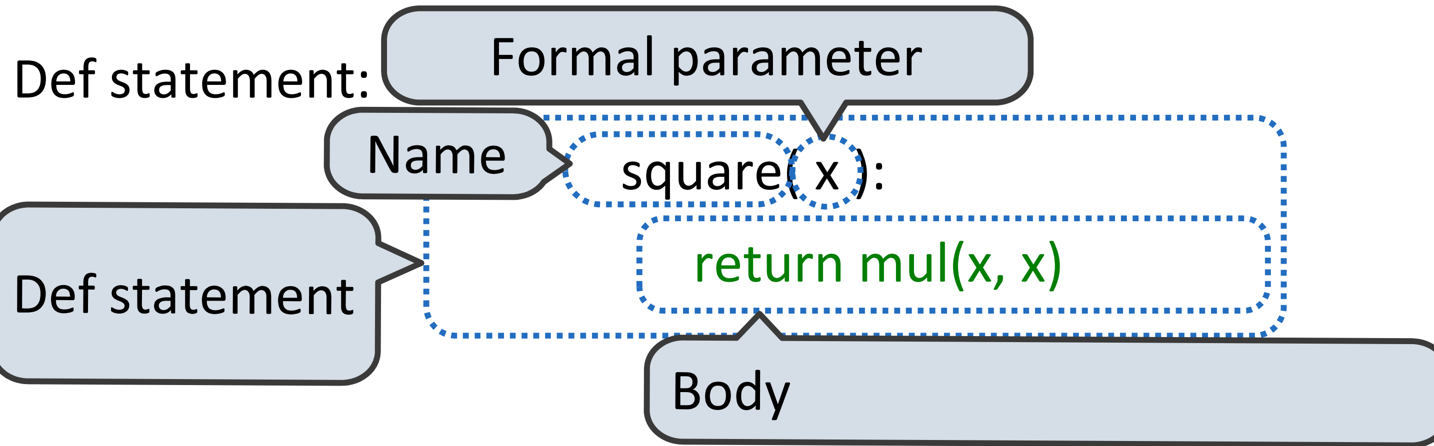

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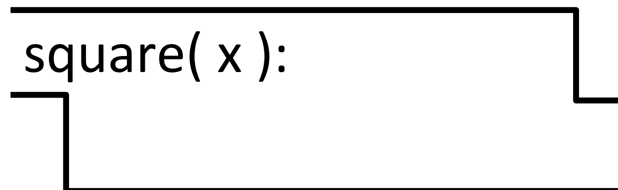

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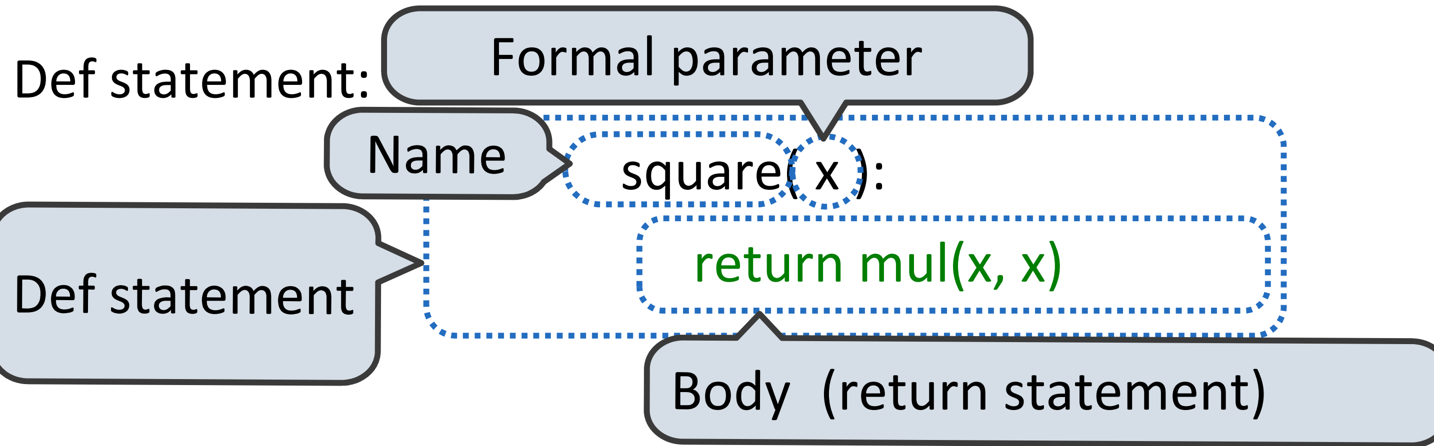

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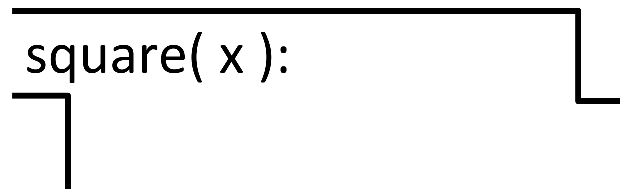

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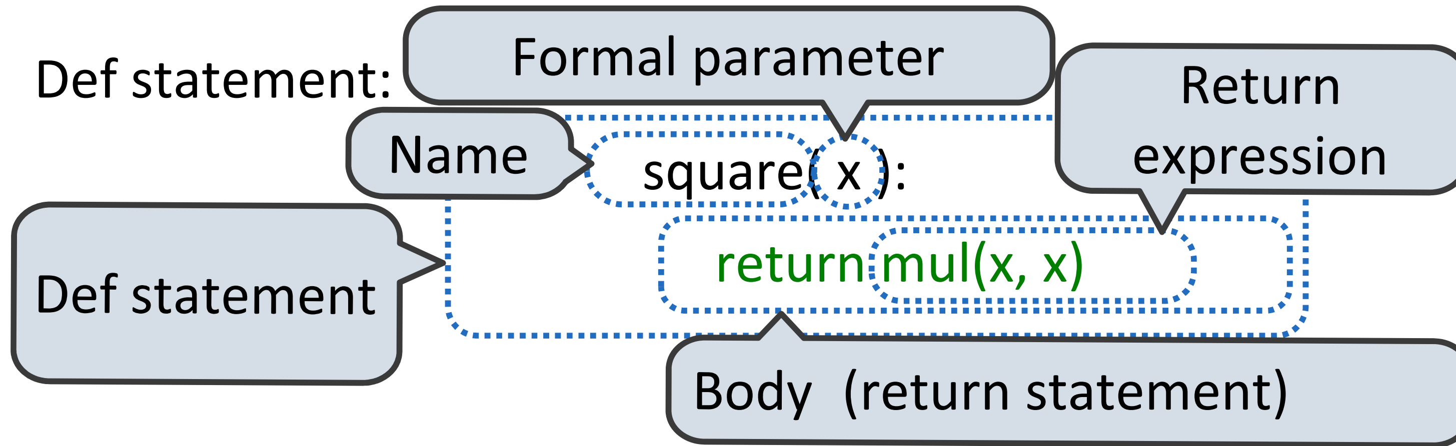

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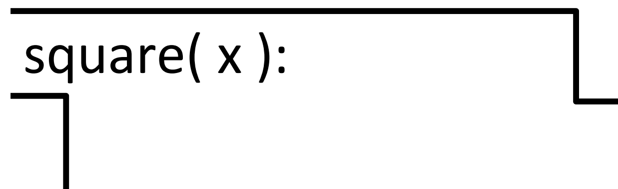

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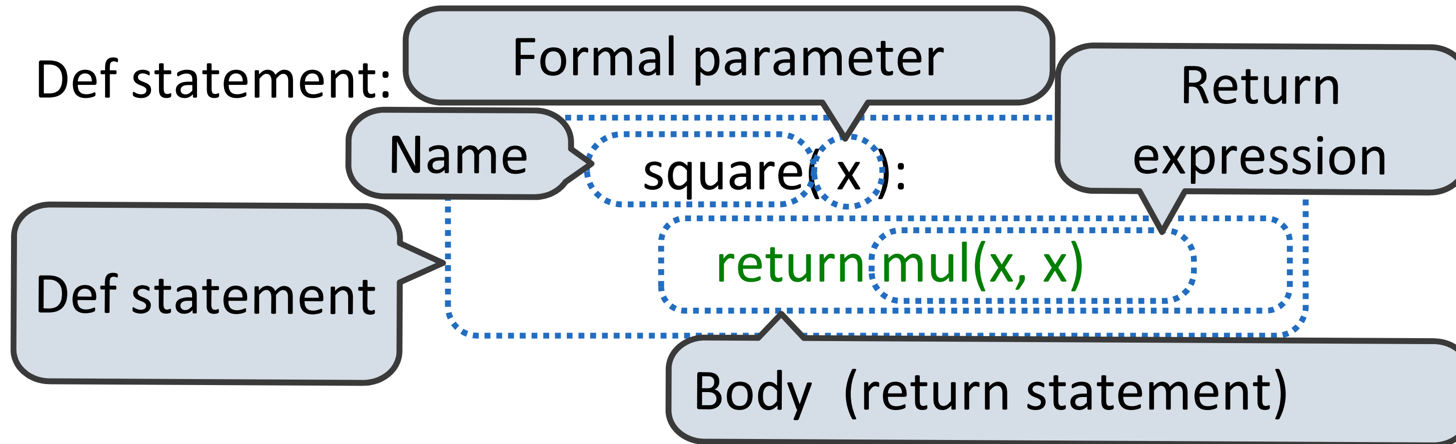

What happens?

Function created

Call expression: square(2+2)

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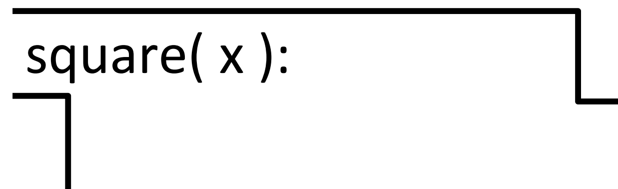

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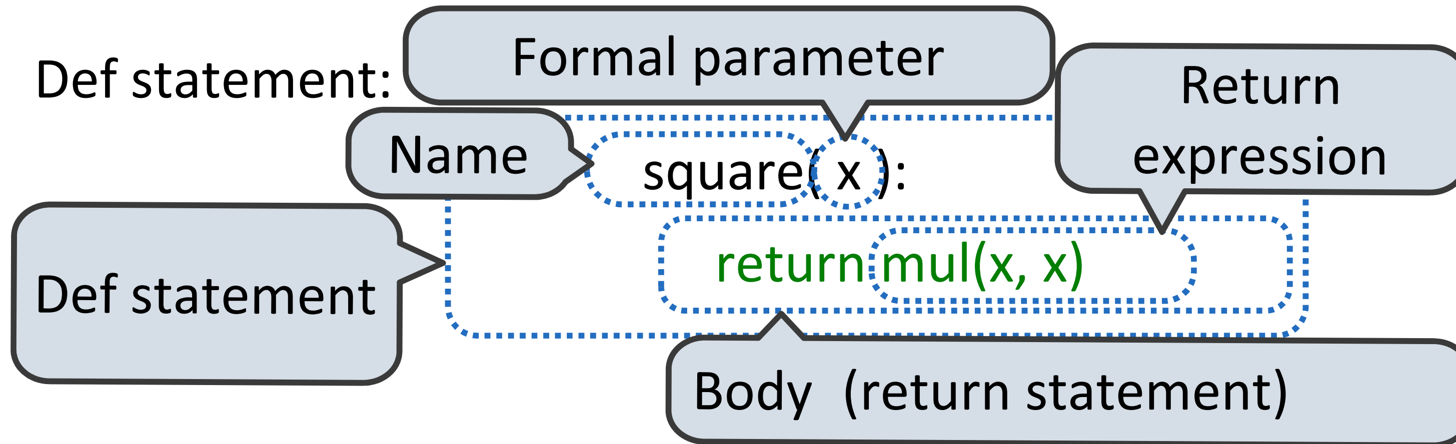

What happens?

Function created

Name bound

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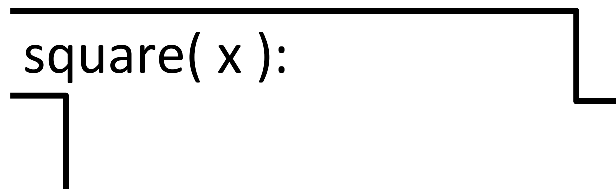

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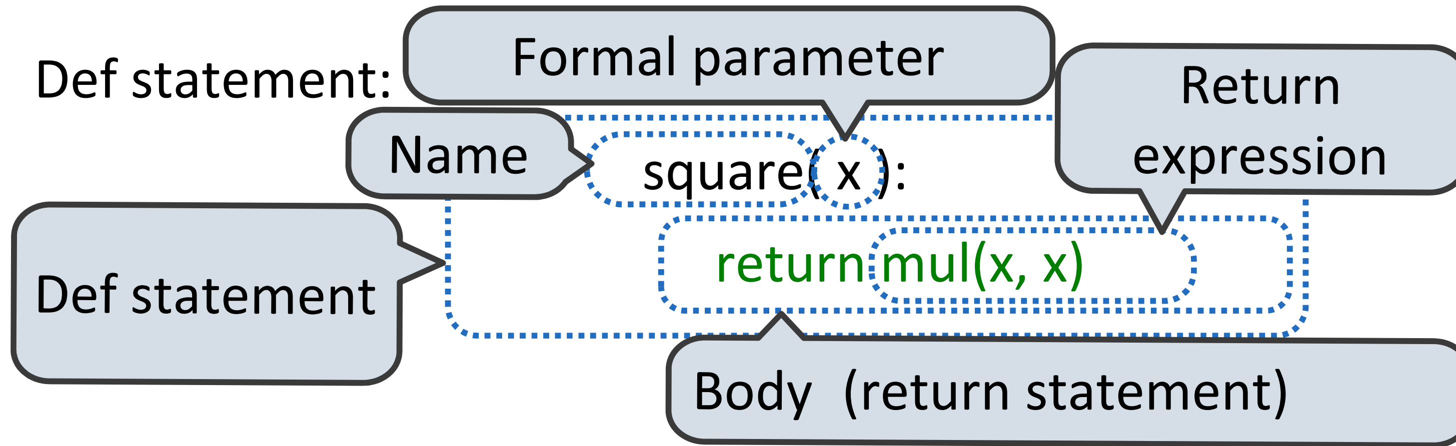

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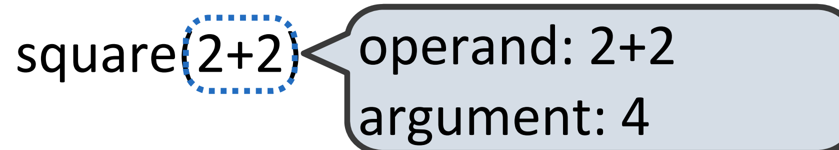

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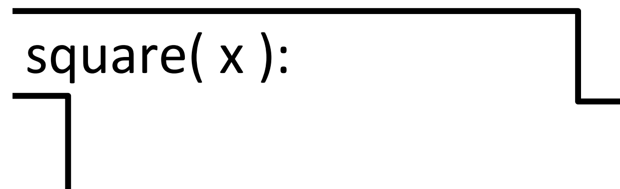

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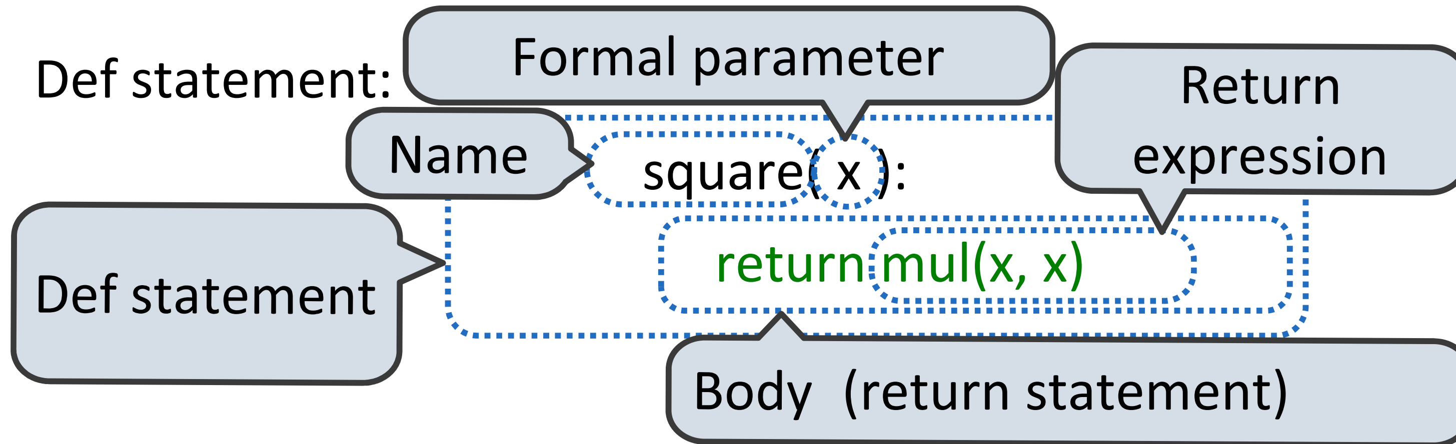

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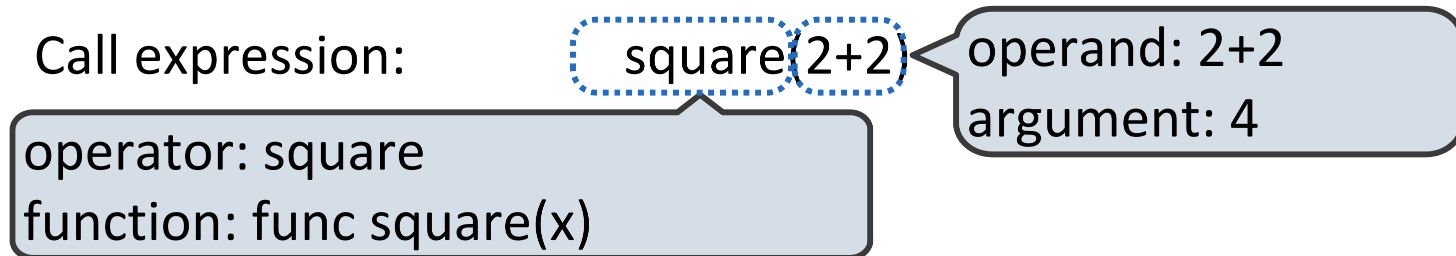

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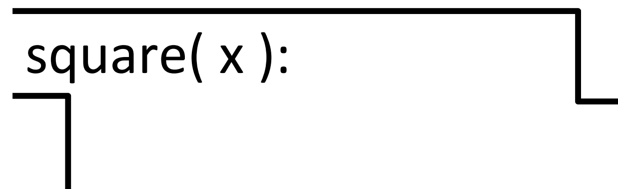

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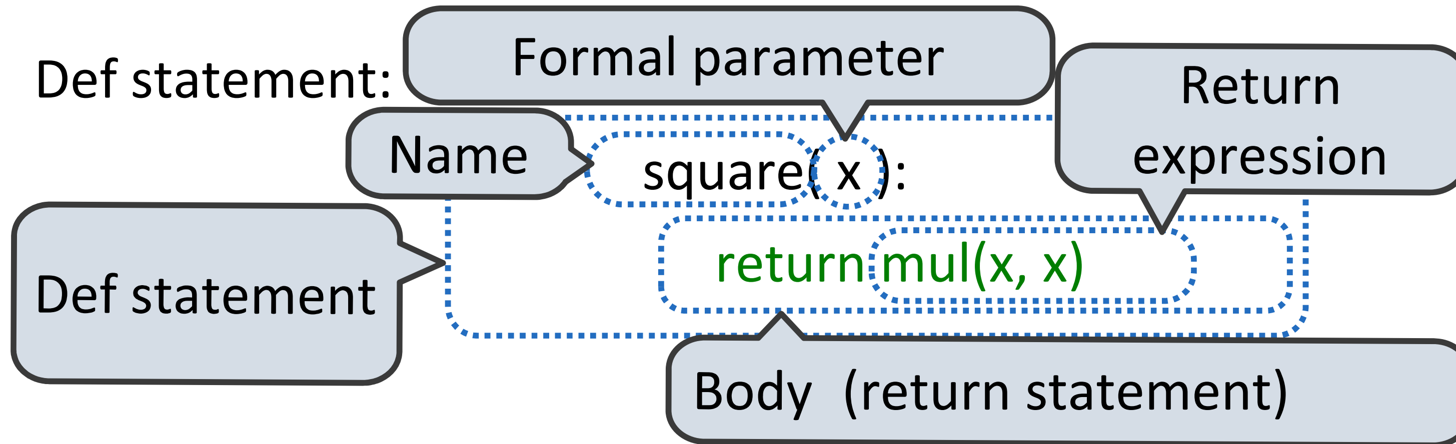

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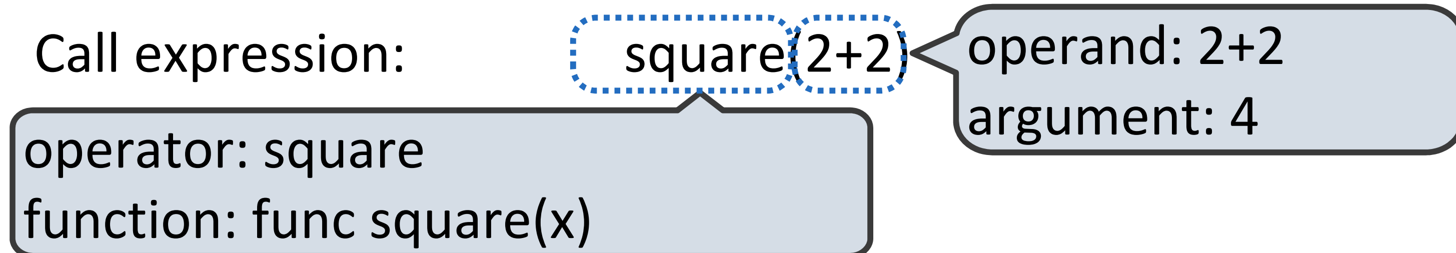
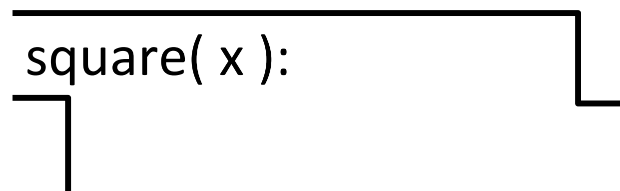


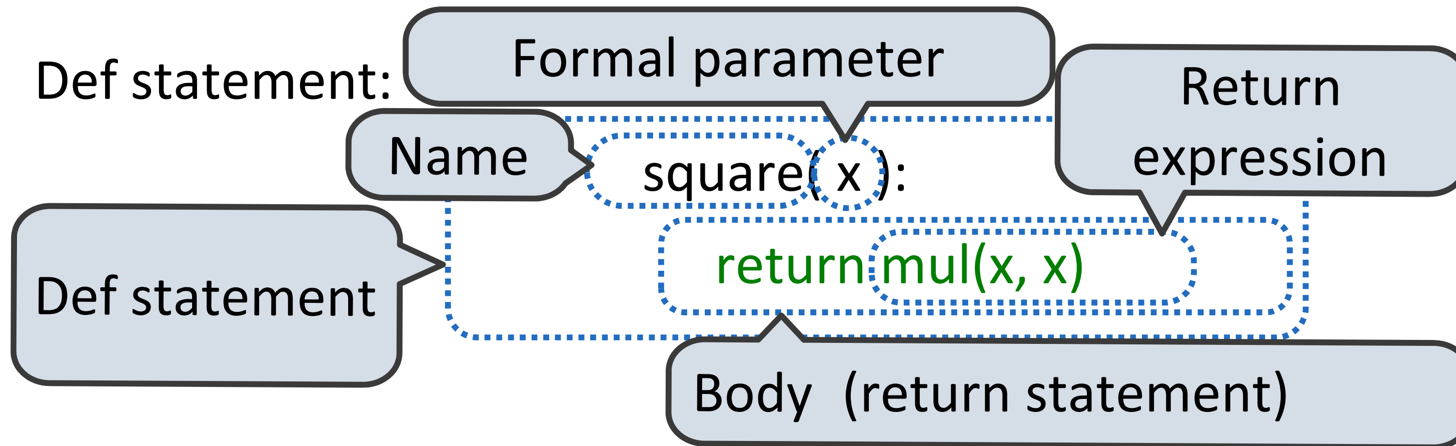
Op's evaluated

Calling/Applying:



Life Cycle of a User-Defined Function

Def statement:



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Function created

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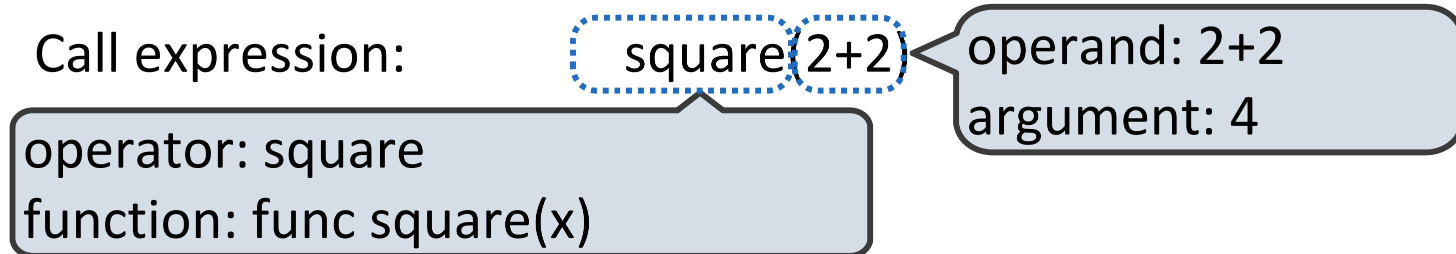
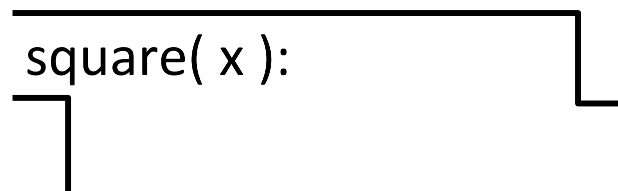
Call expression:



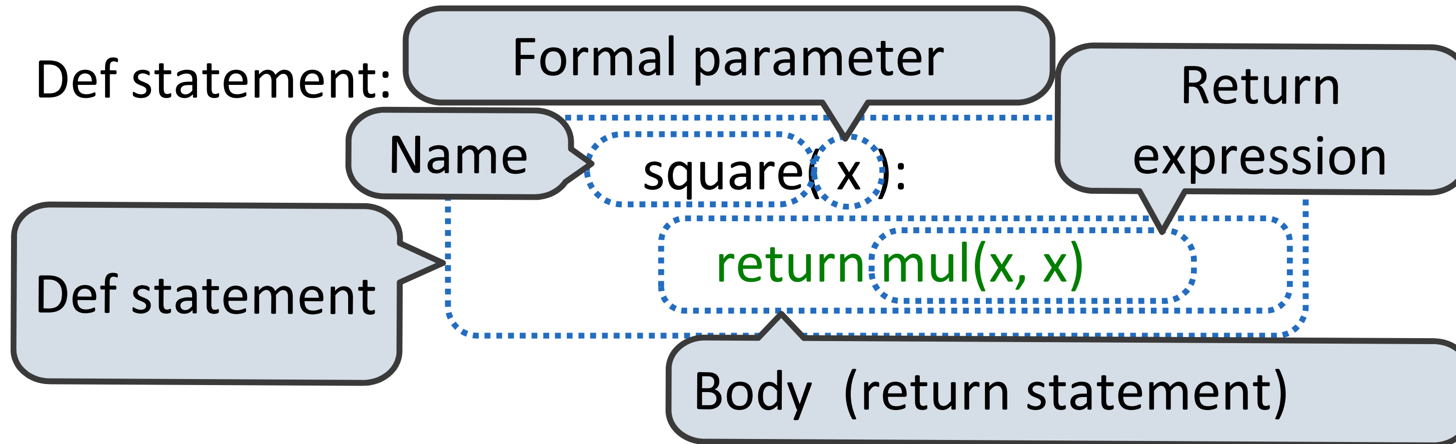
Op's evaluated

Function called with argument(s)

Calling/Applying:



Life Cycle of a User-Defined Function



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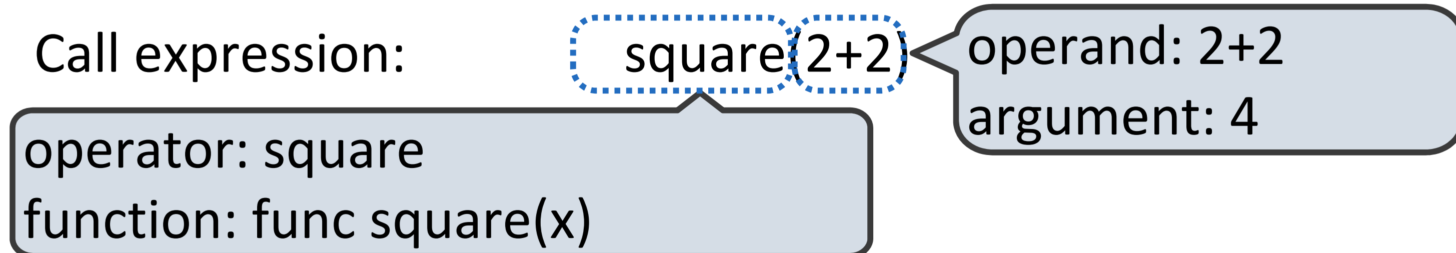

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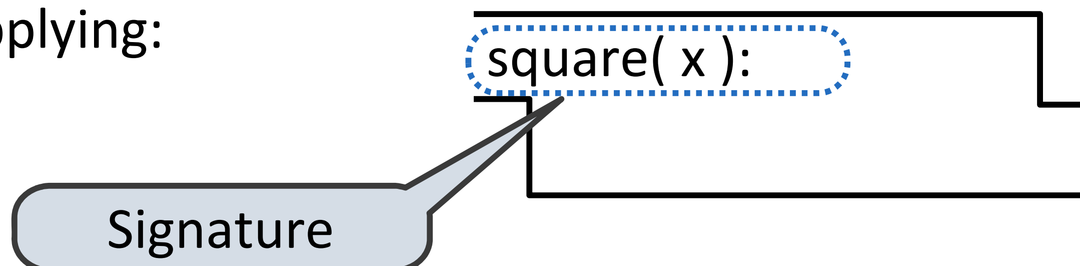

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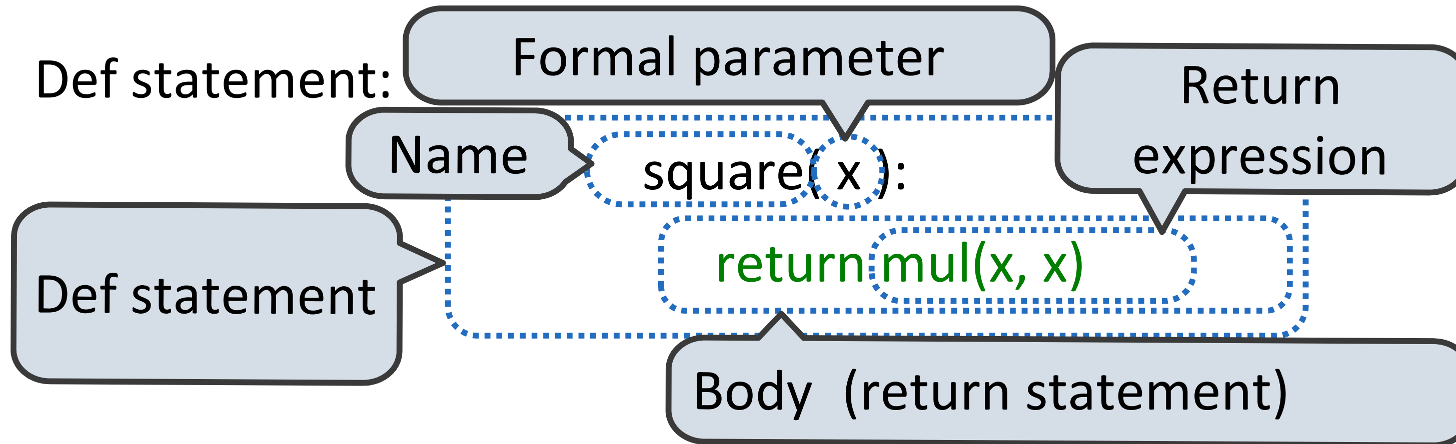

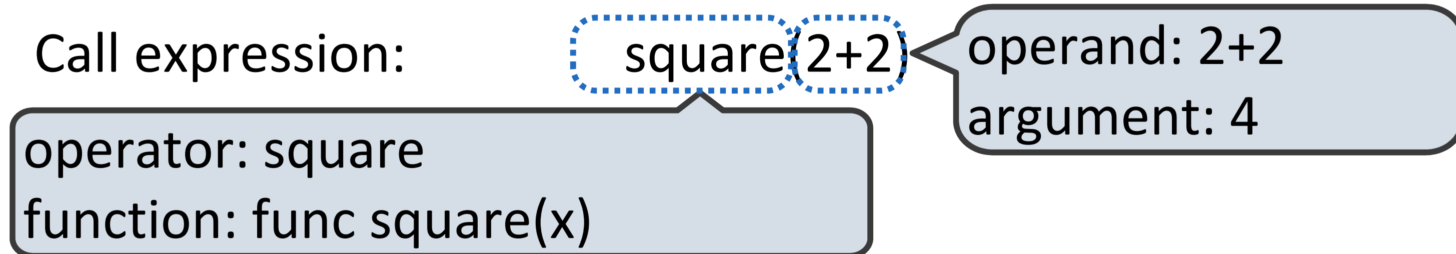

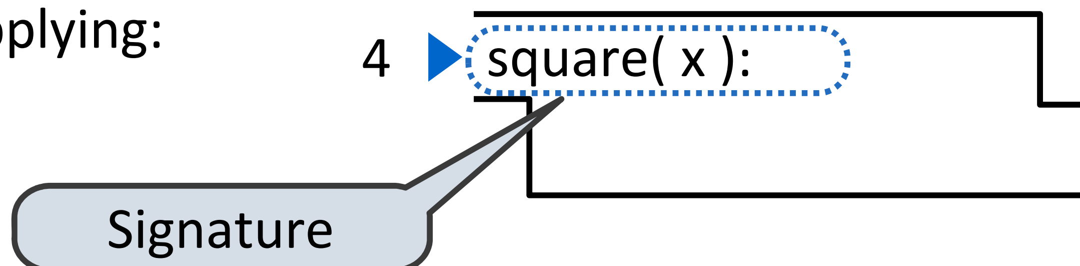

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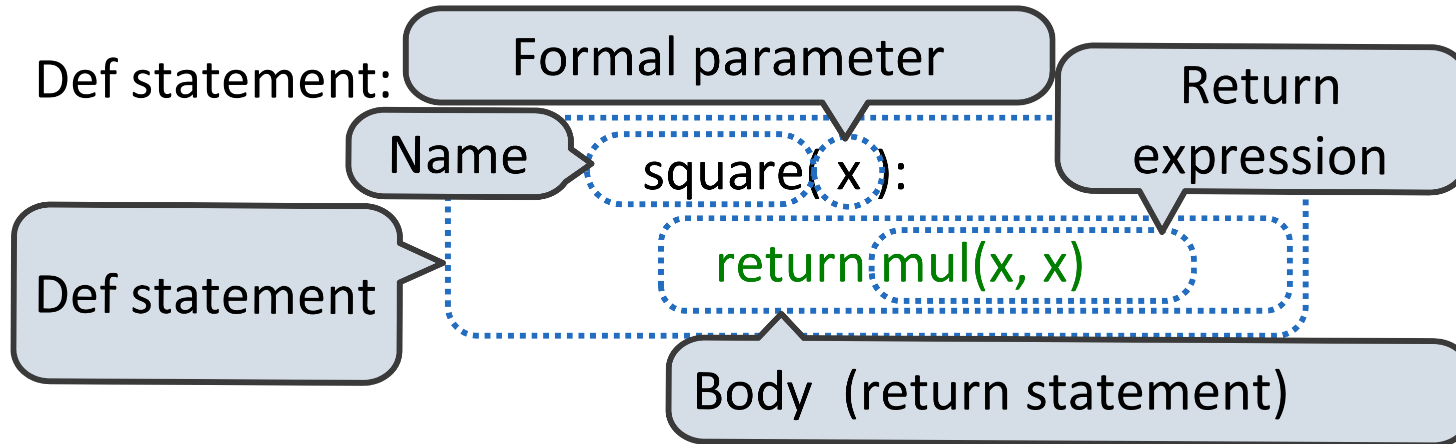
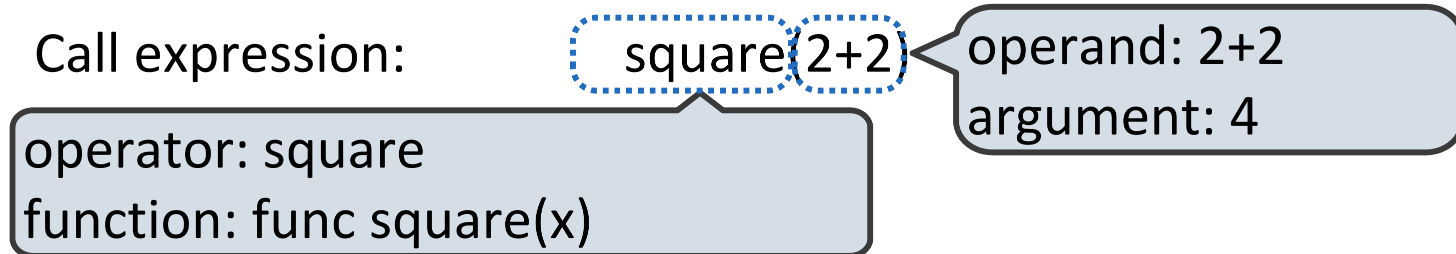
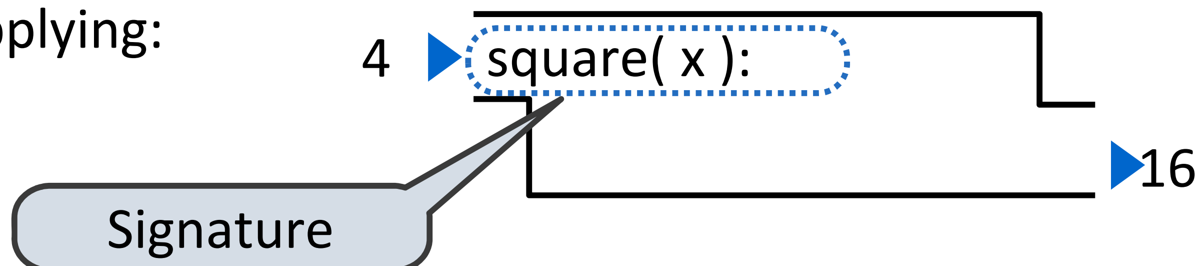
Life Cycle of a User-Defined Function







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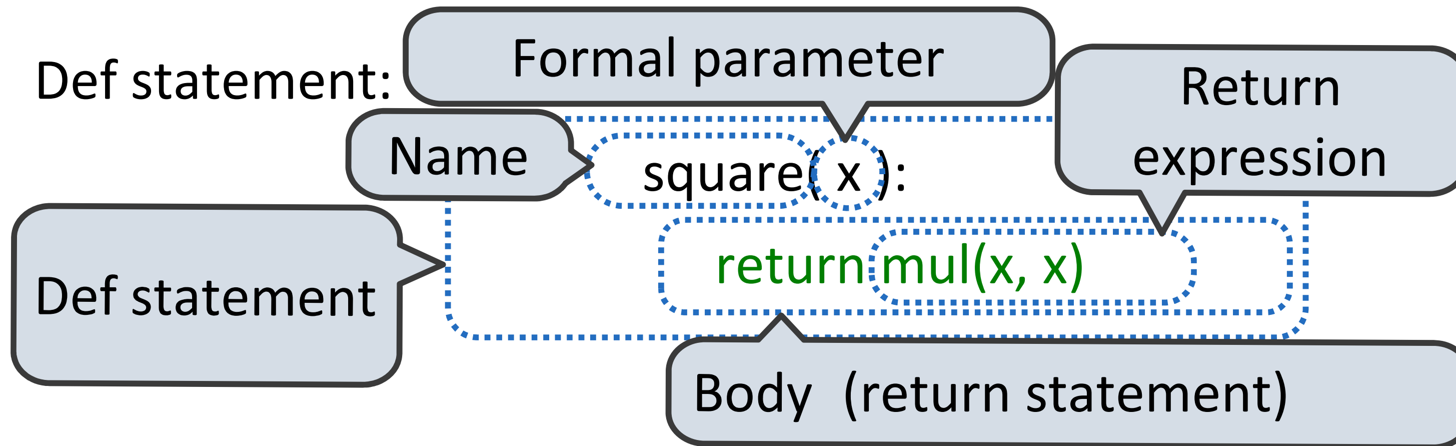
Function called with argument(s)

Life Cycle of a User-Defined Function



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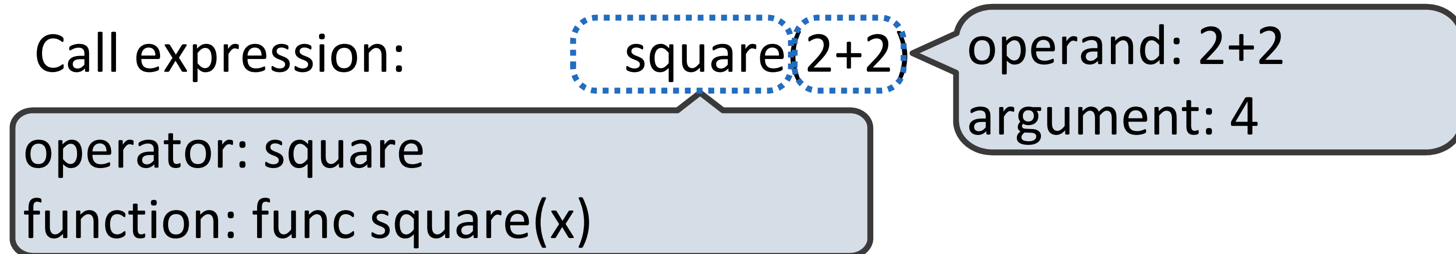

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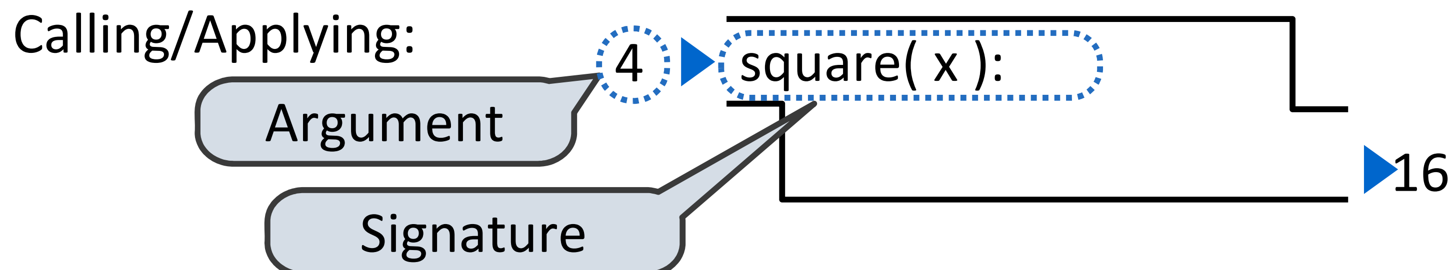
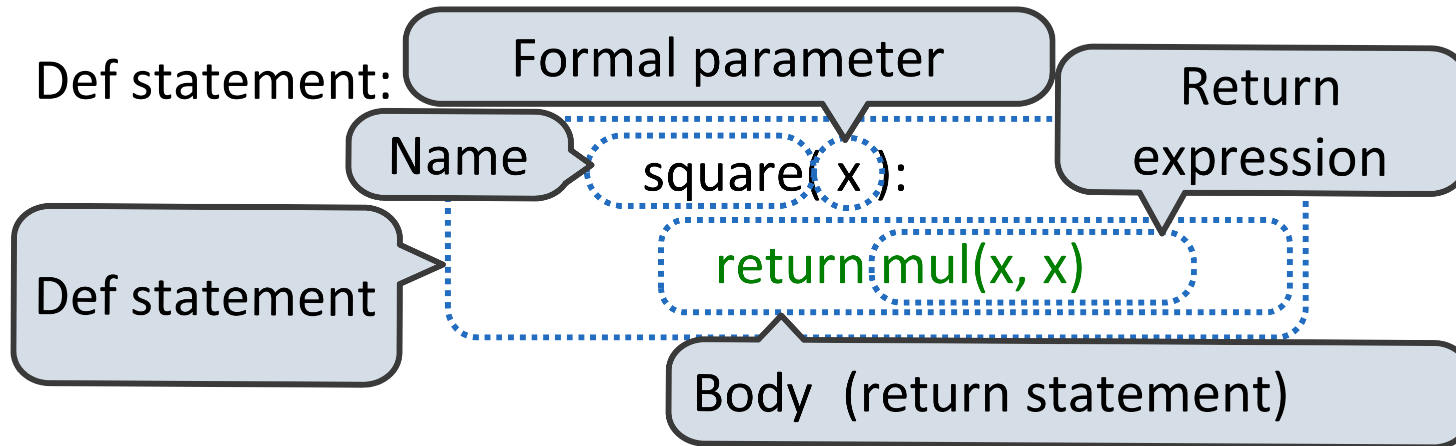


Life Cycle of a User-Defined Function



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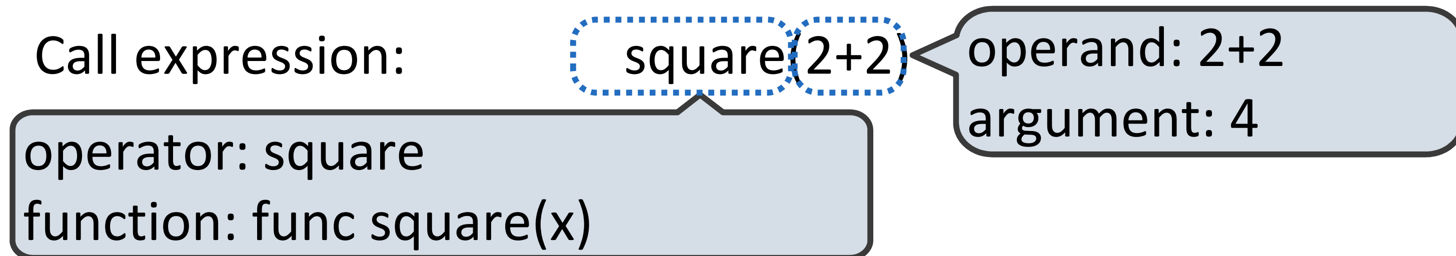
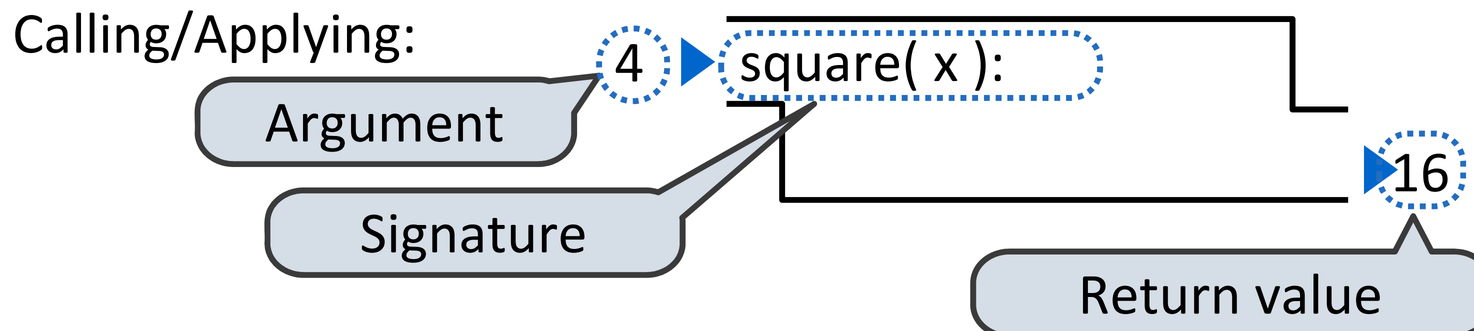


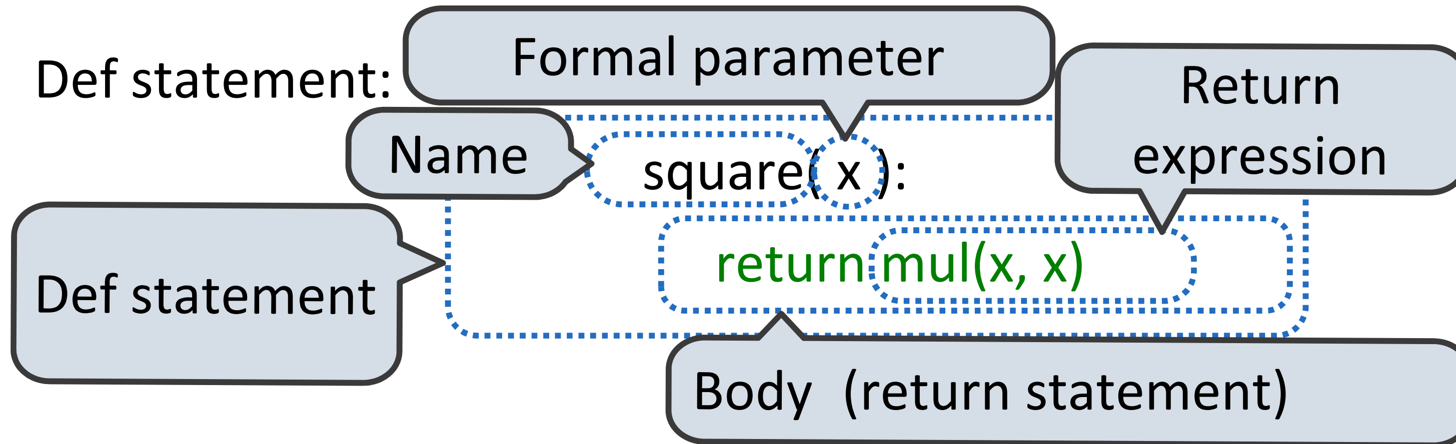
Op's evaluated

Function called with argument(s)

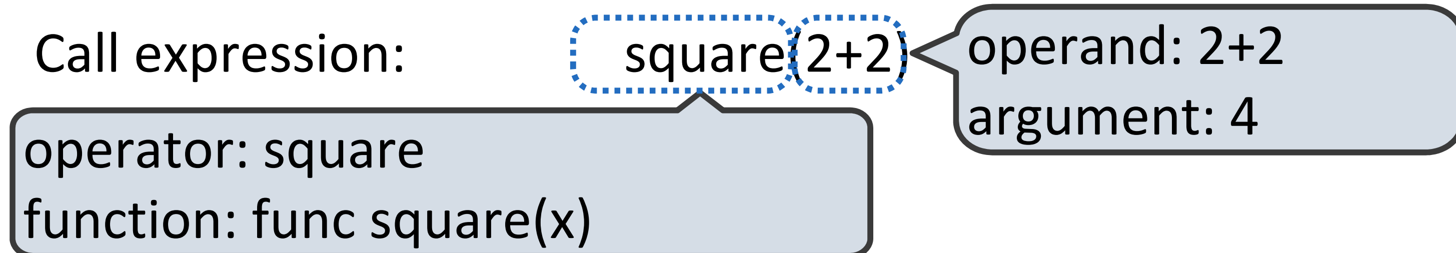


Life Cycle of a User-Defined Function

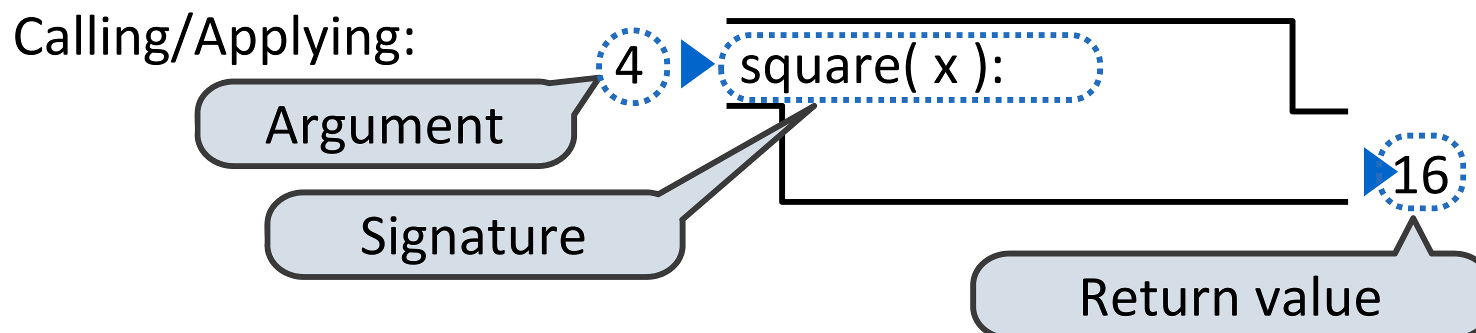
Def statement:



Call expression:



Calling/Applying:



What happens?

Function created

Name bound

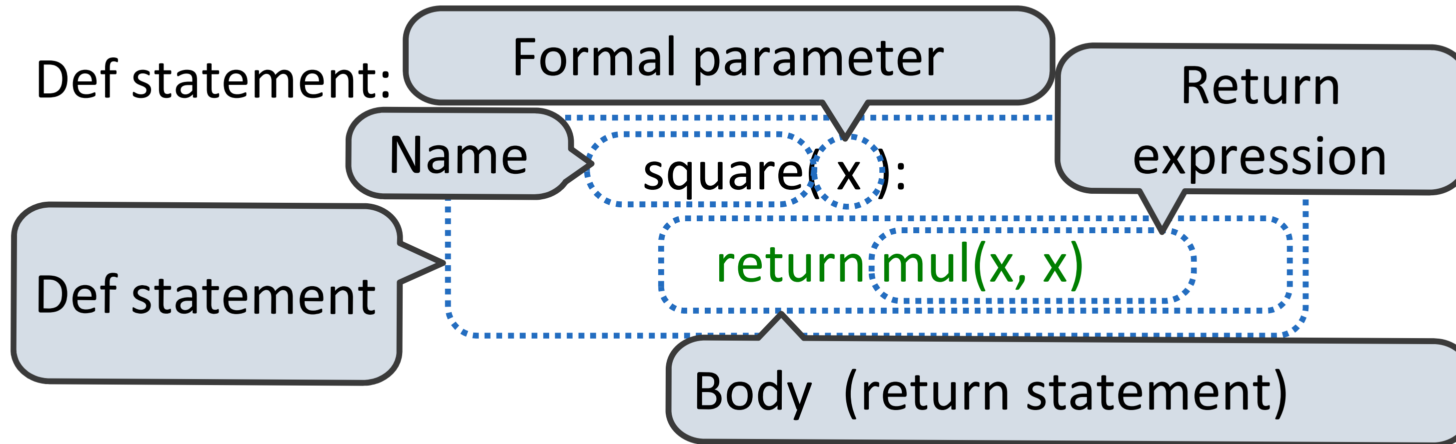
Op's evaluated

Function called with argument(s)

New frame!

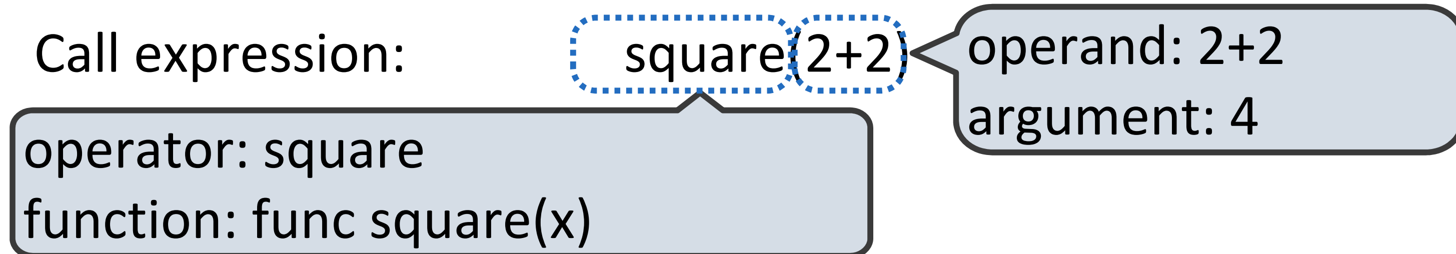
Life Cycle of a User-Defined Function

What happens?



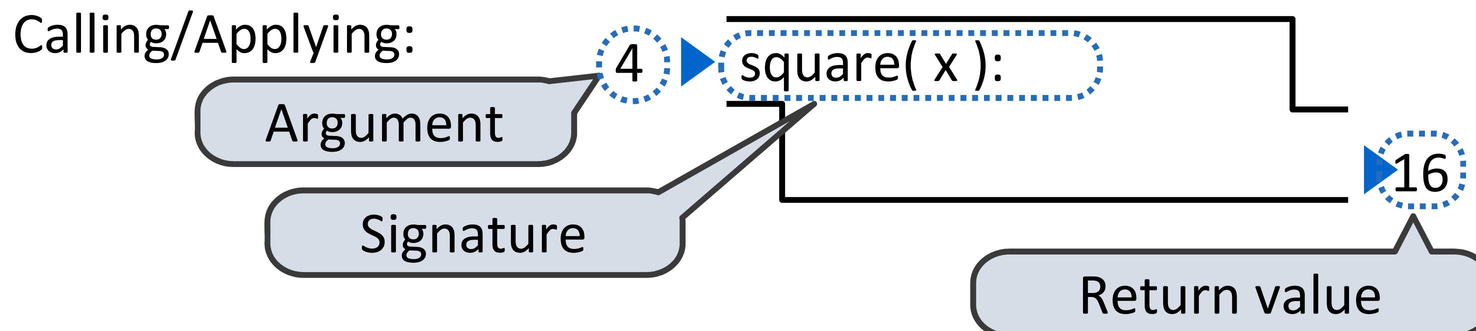
Function created

Name bound



Op's evaluated

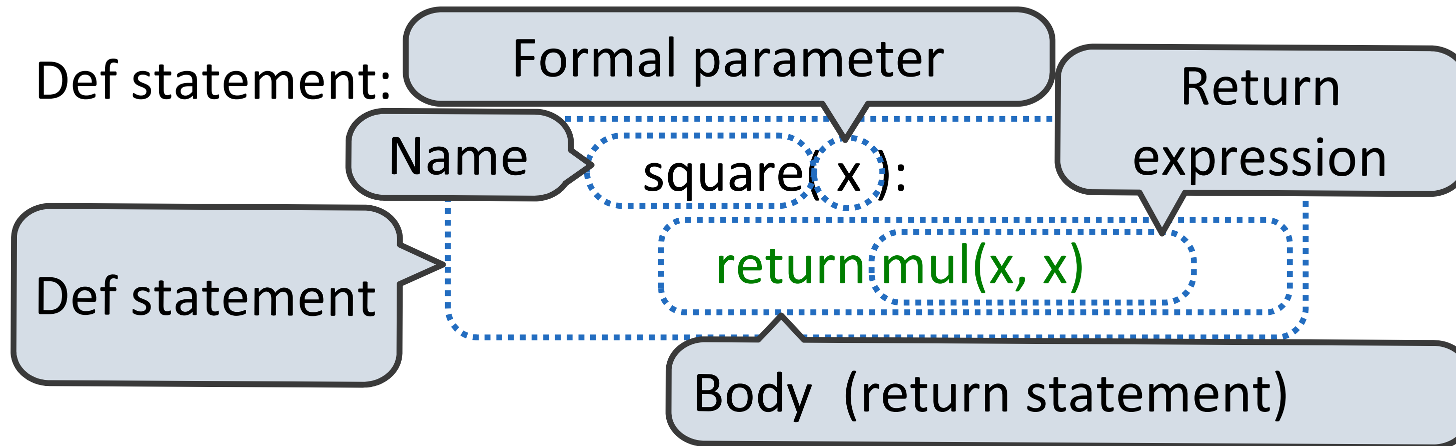
Function called with argument(s)

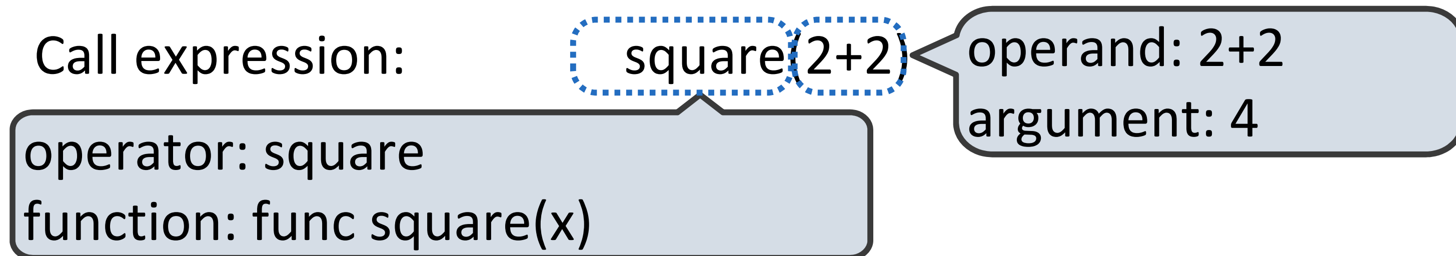


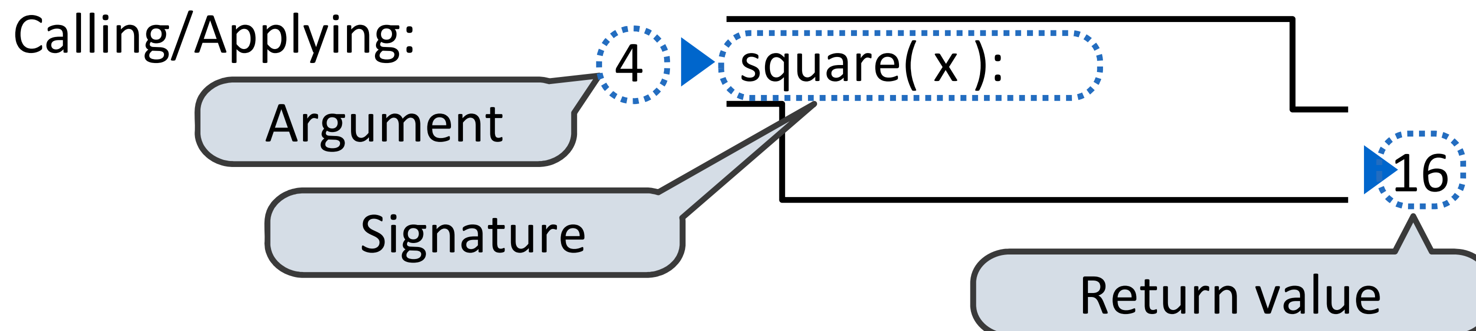
New frame!

Params bound

Life Cycle of a User-Defined Function







What happens?

Function created

Name bound

Op's evaluated

Function called with argument(s)

New frame!

Params bound

Body executed