Functions

Announcements

Expressions

Types of expressions

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Types of expressions

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Call Expressions in Python

All expressions can use function call notation

(Demo)

Anatomy of a Call Expression

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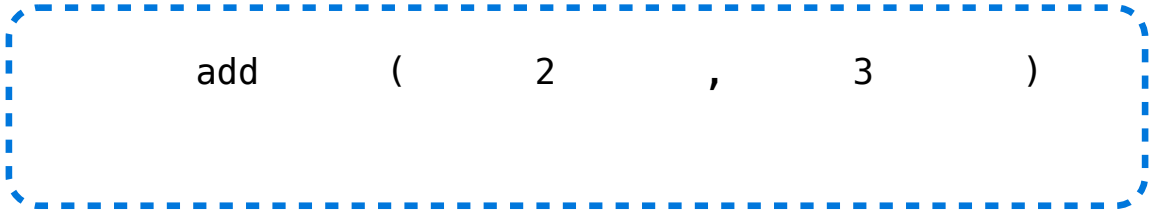
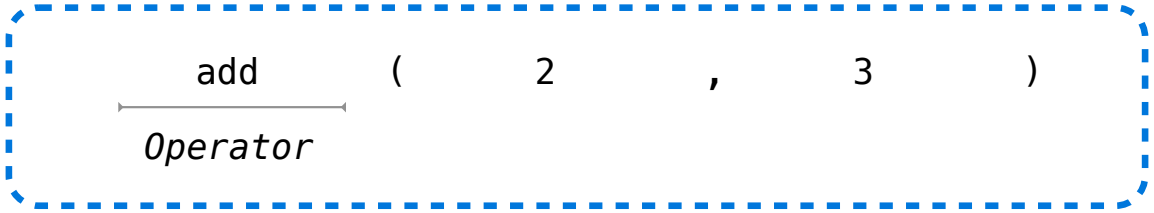
```
add     (     2     ,     3     )
```

Anatomy of a Call Expression



Anatomy of a Call Expression



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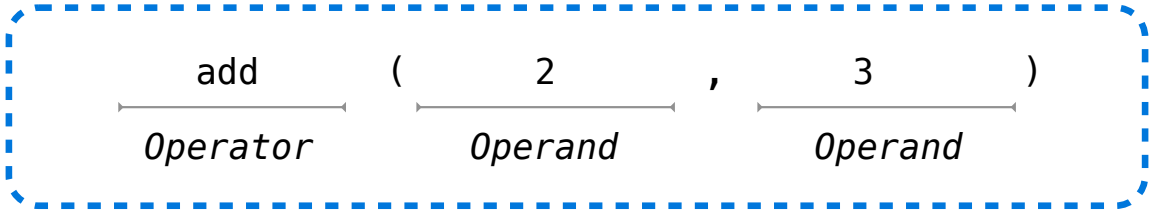

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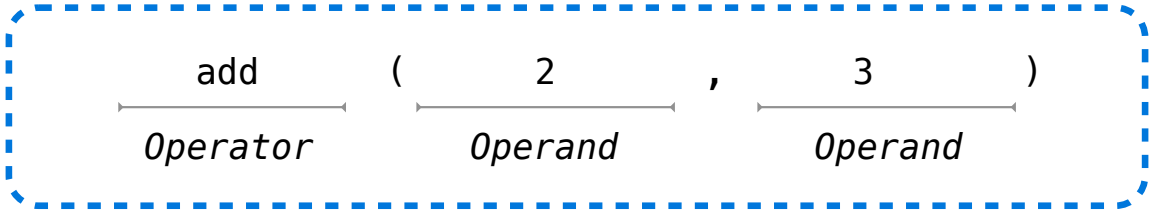
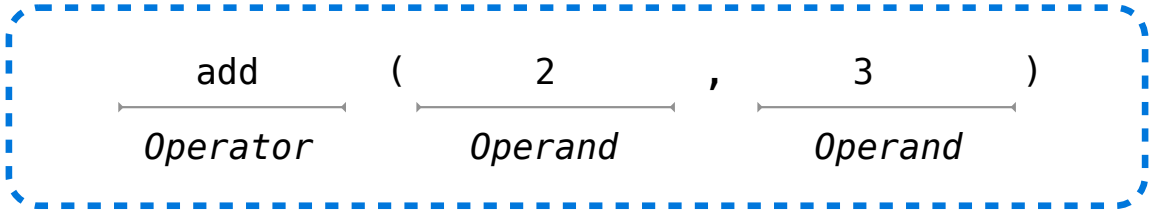


Operators and operands are also expressions

Anatomy of a Call Expression



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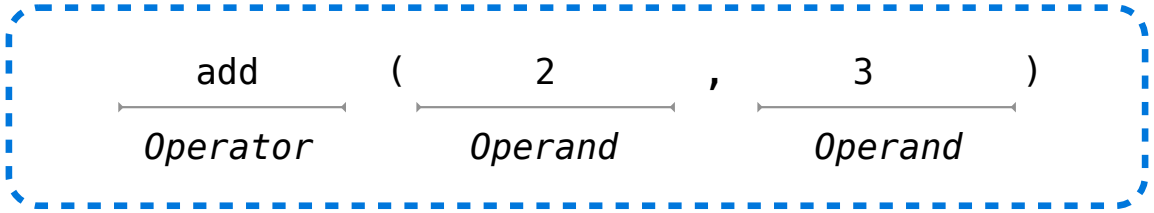

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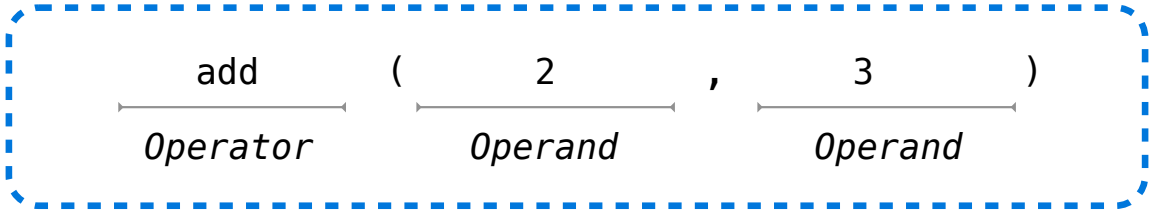

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1. Evaluate the operator and then the operand subexpressions

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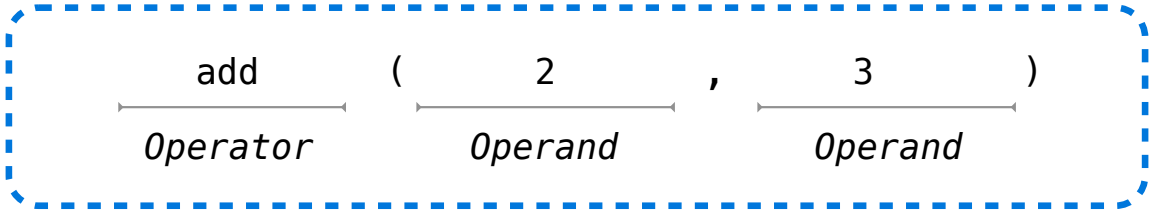

Operators and operands are also expressions

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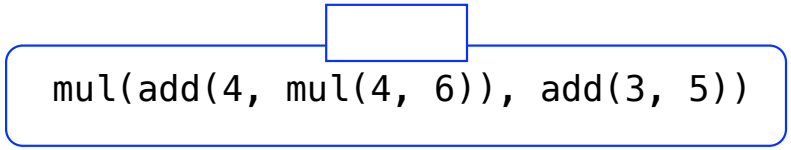
Evaluation procedure for call expressions:

1. Evaluate the operator and then the operand subexpressions
2. Apply the function that is the value of the operator to the arguments that are the values of the operands

Evaluating Nested Expressions

```
mul(add(4, mul(4, 6)), add(3, 5))
```

Evaluating Nested Expressions



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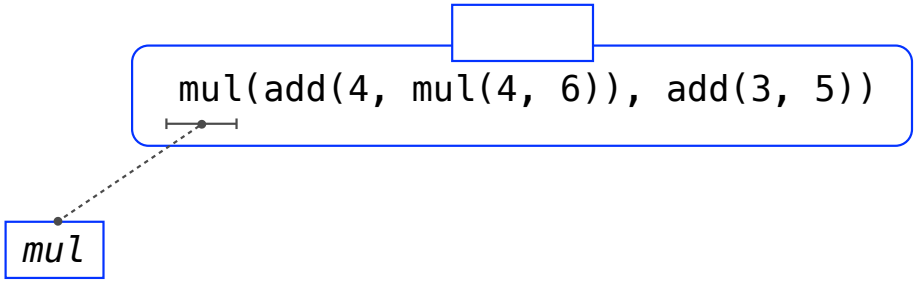

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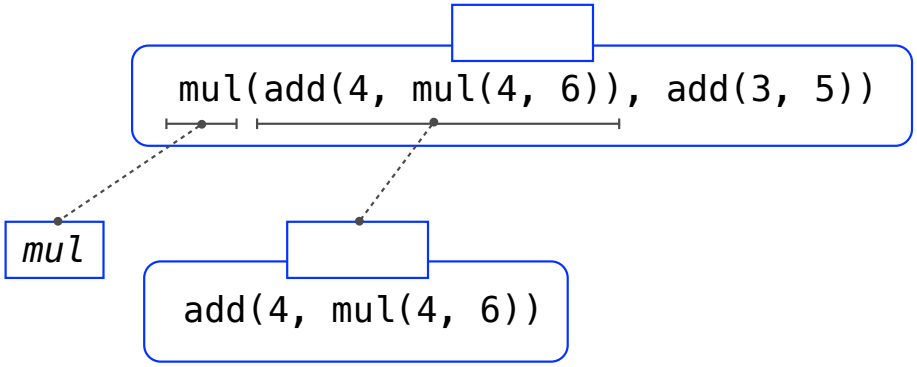

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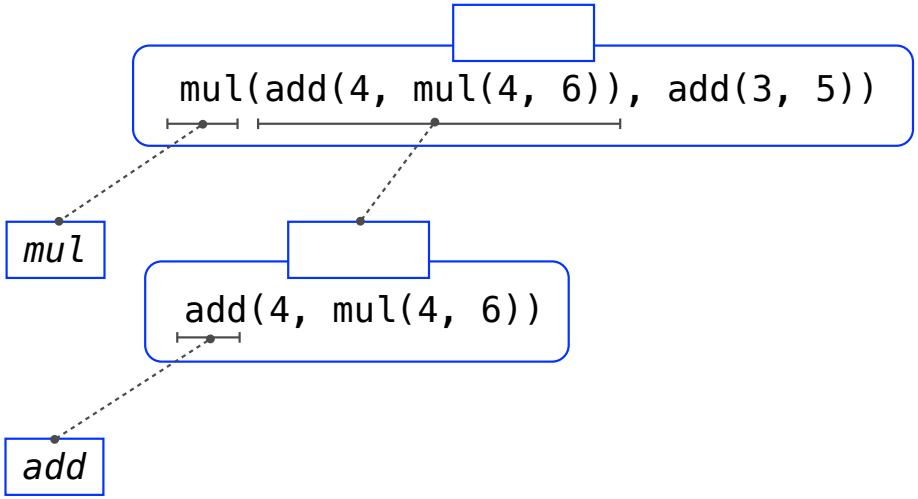

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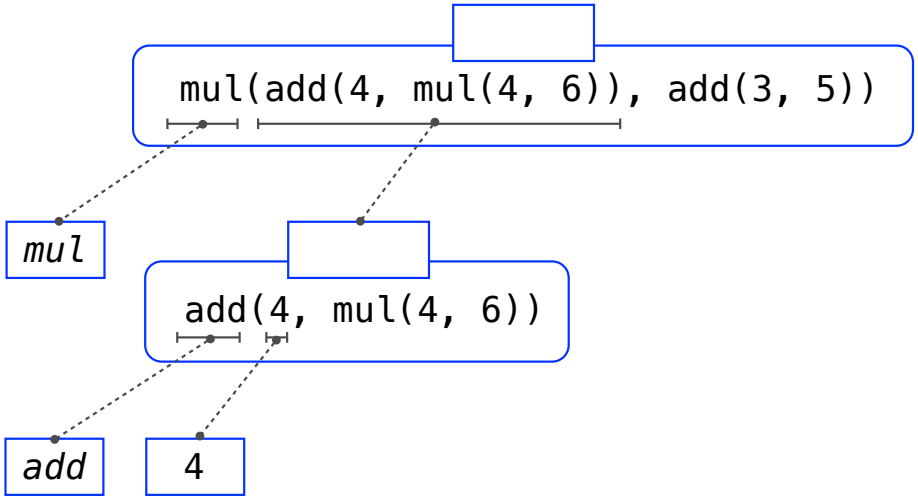

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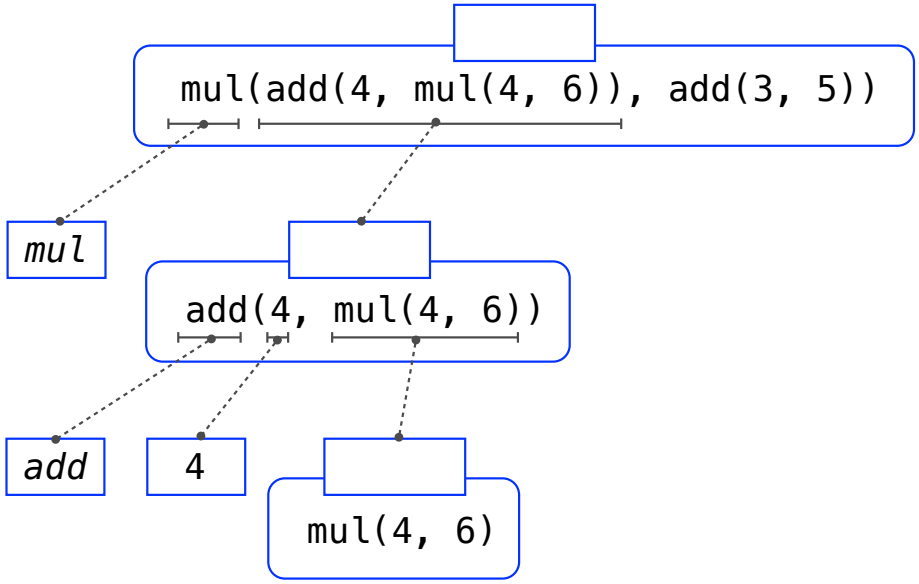

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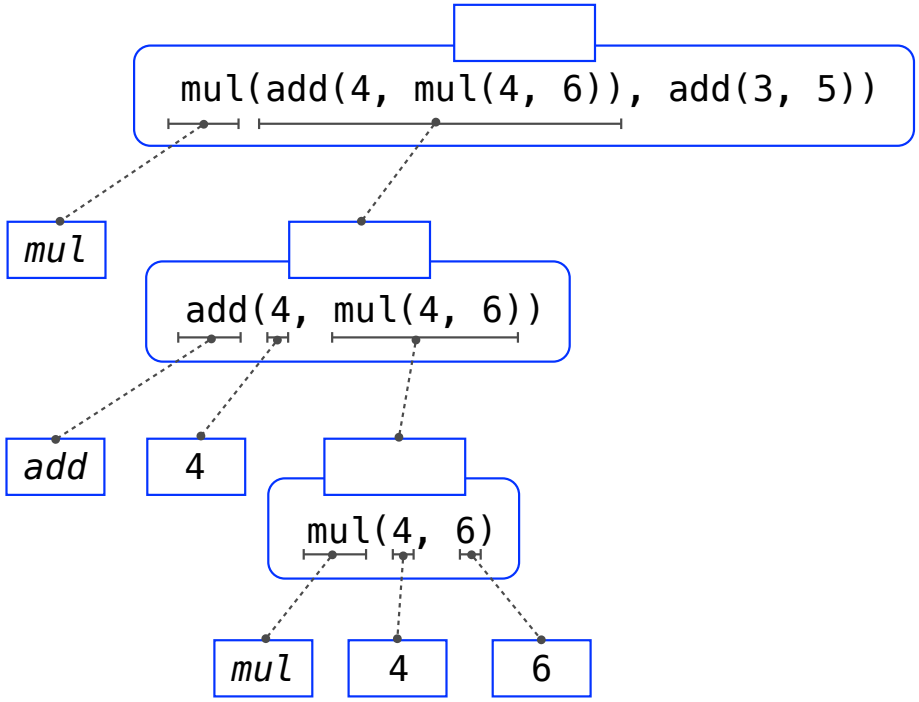

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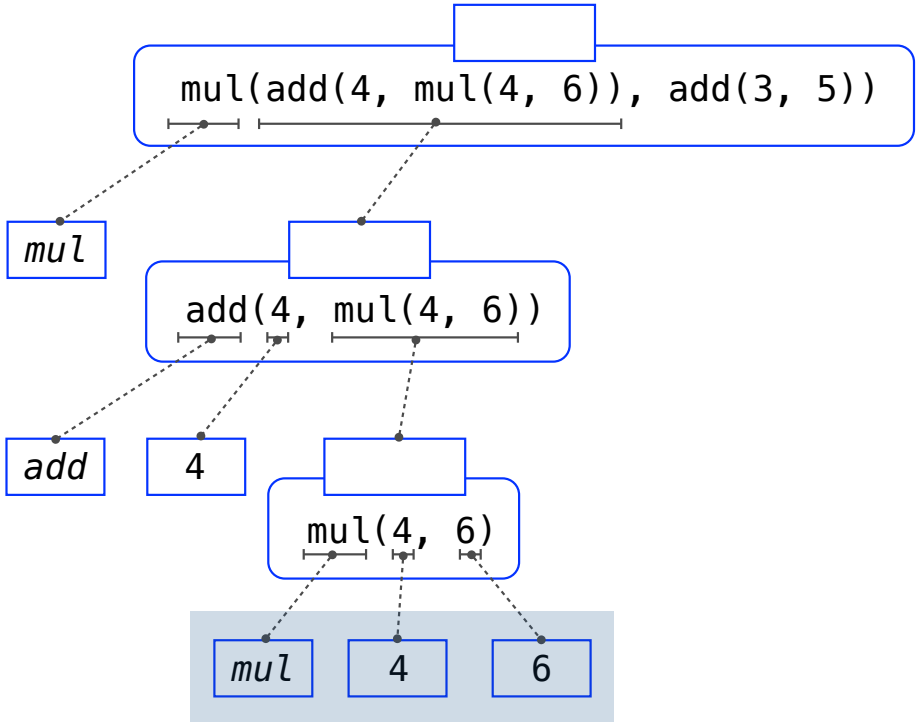

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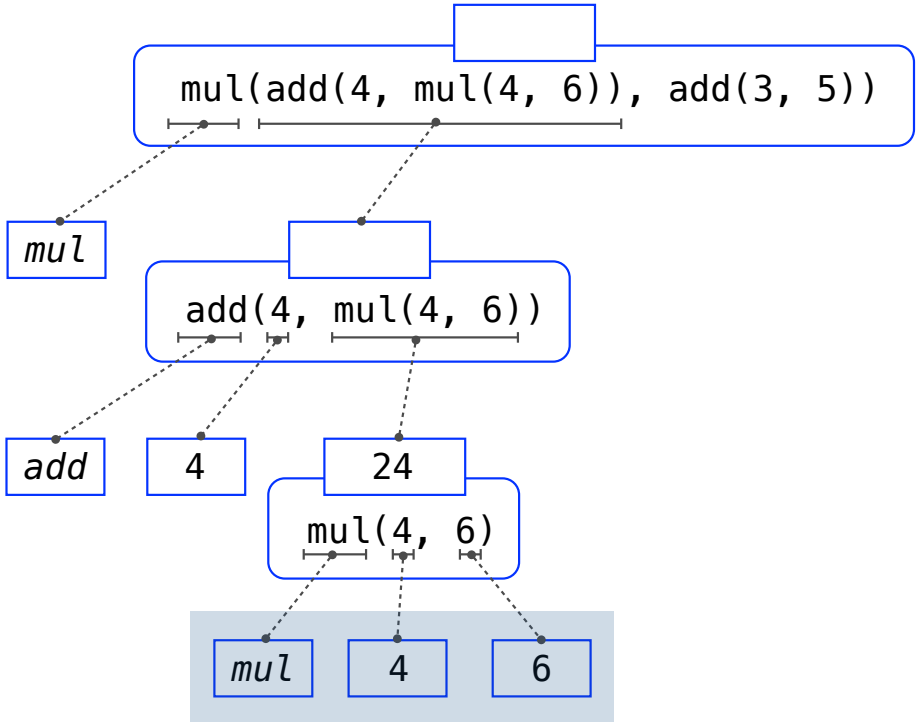

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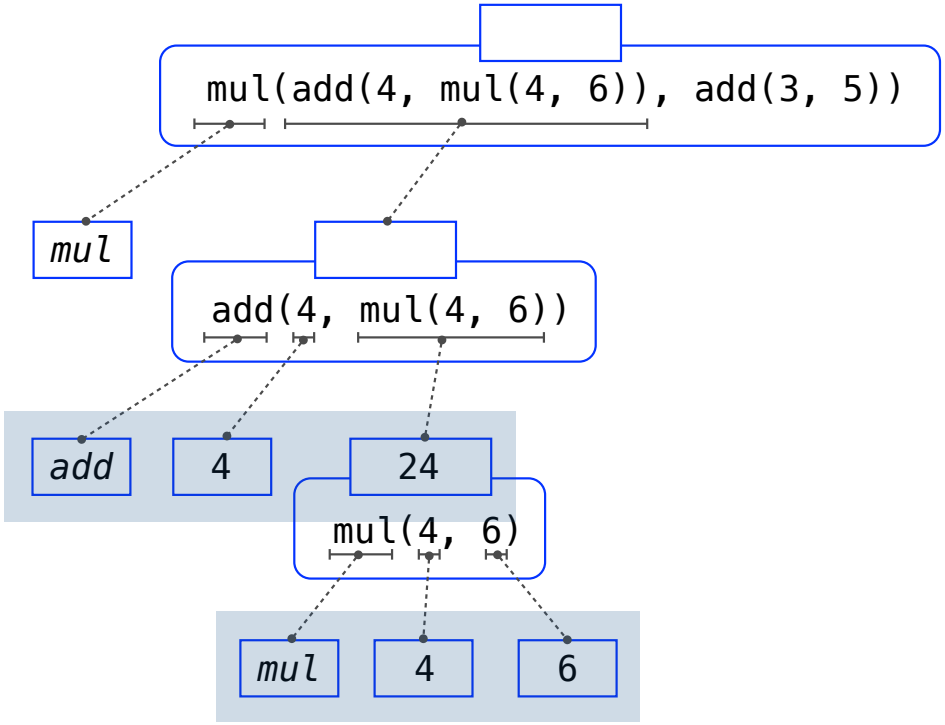

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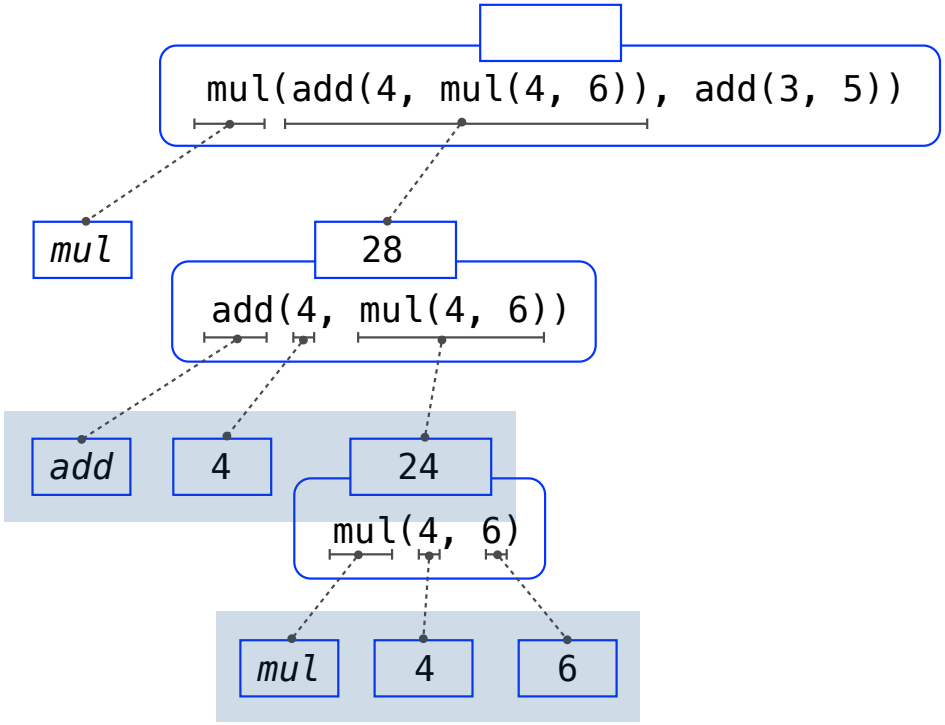

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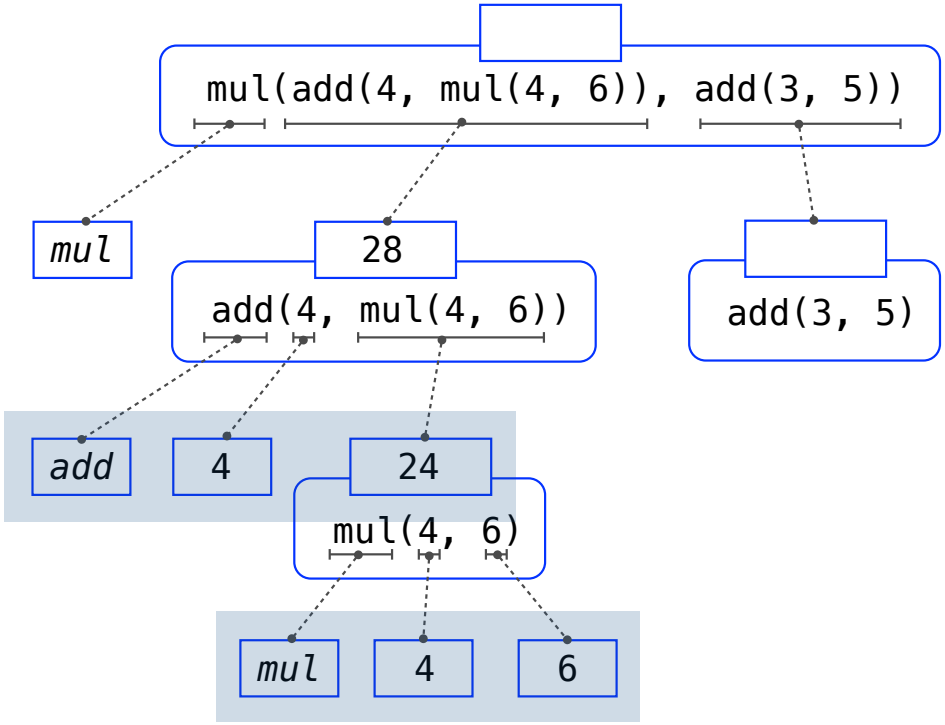

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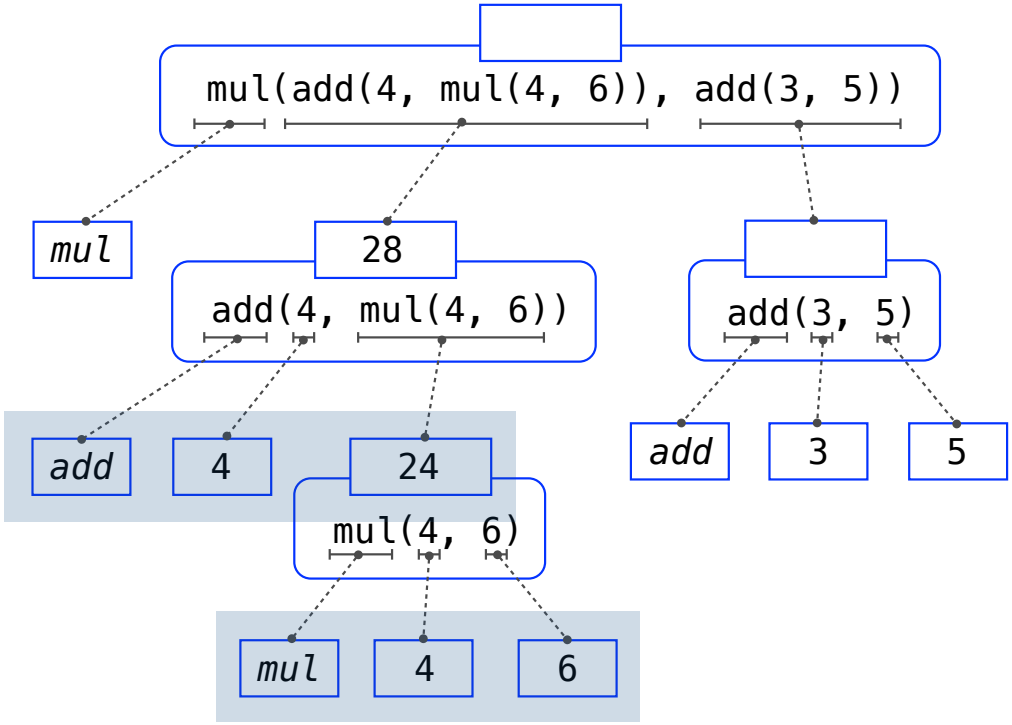

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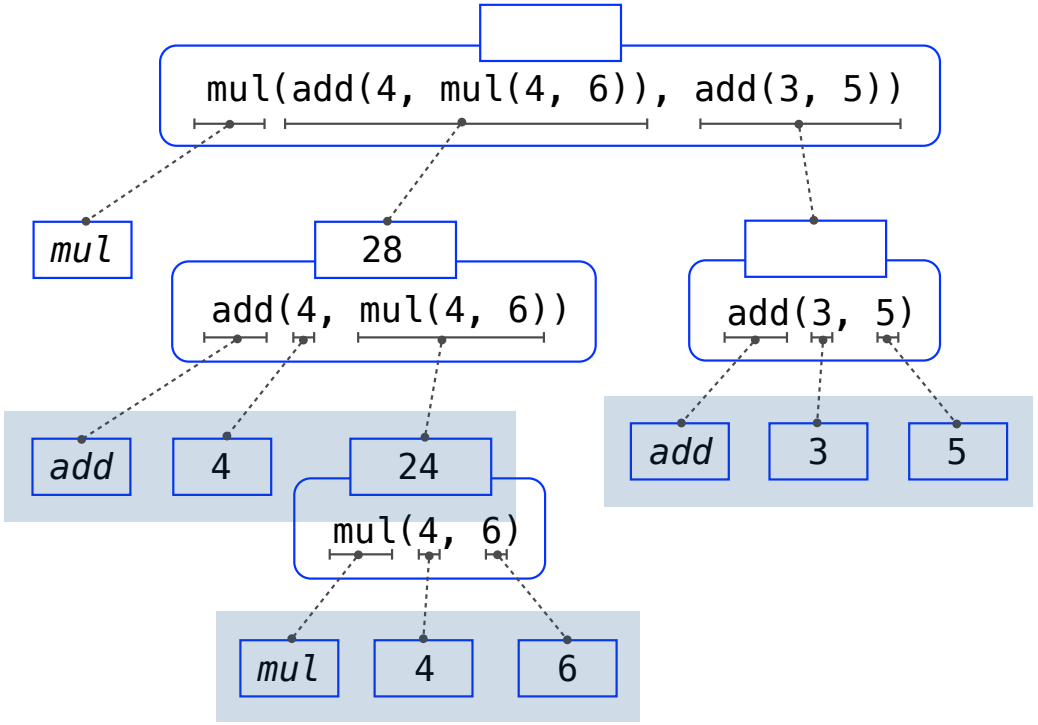

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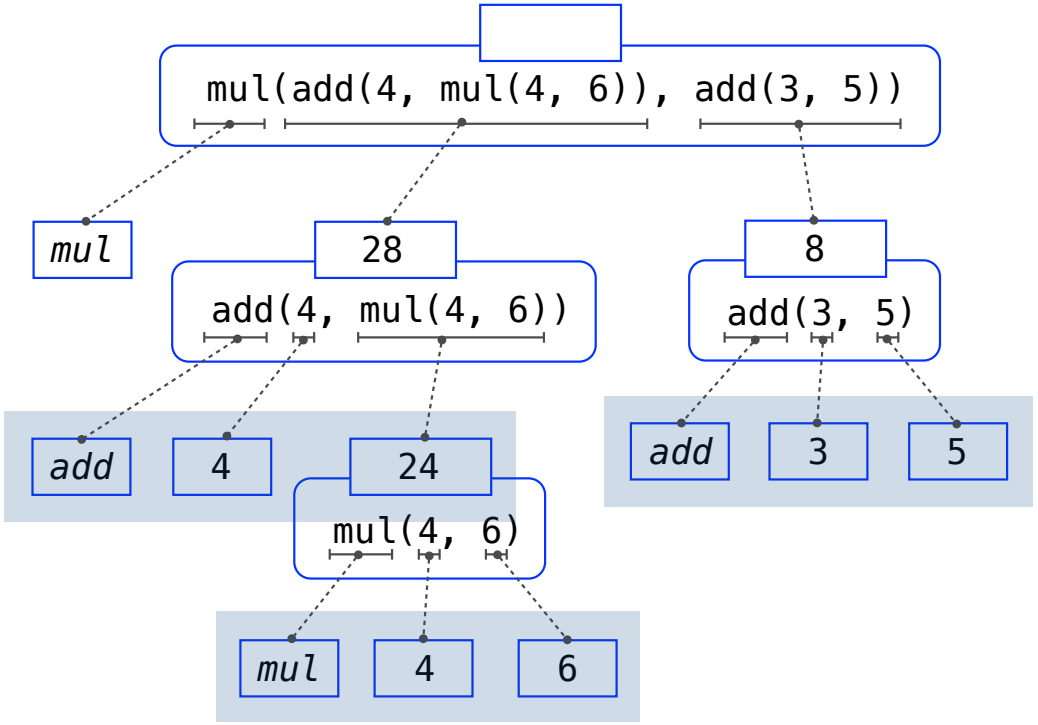

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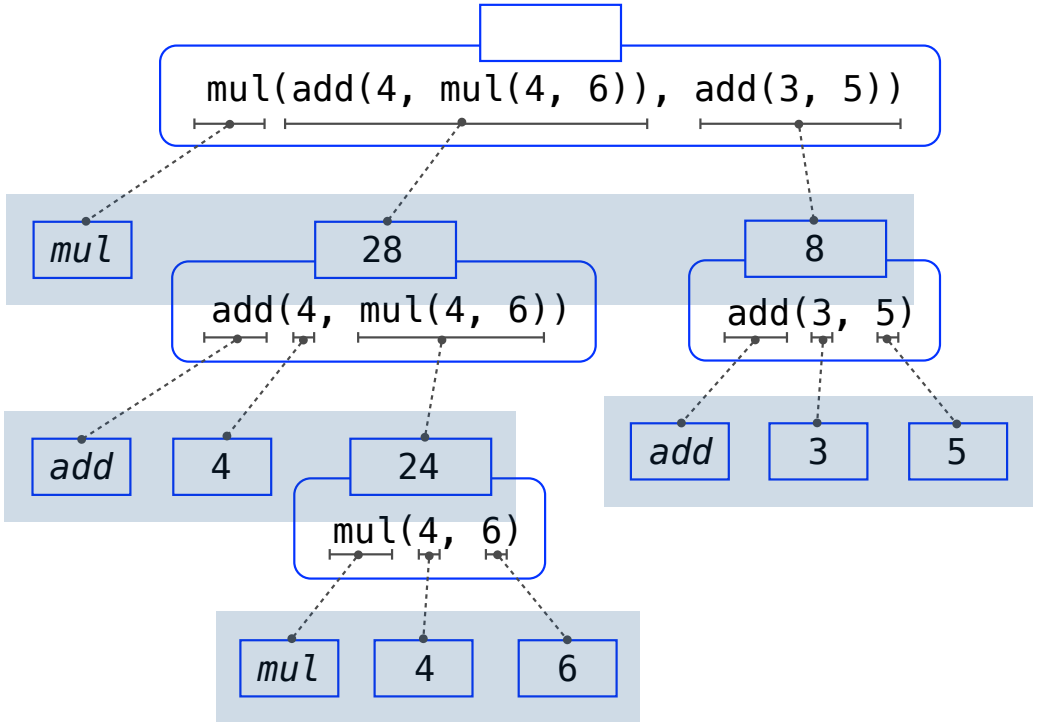

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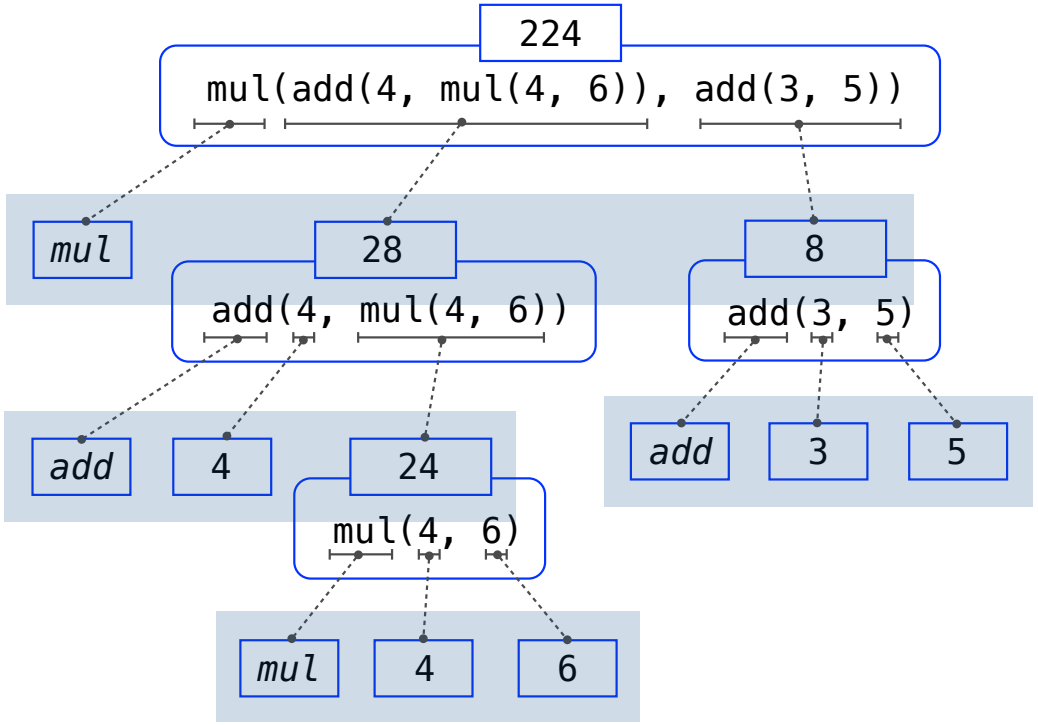

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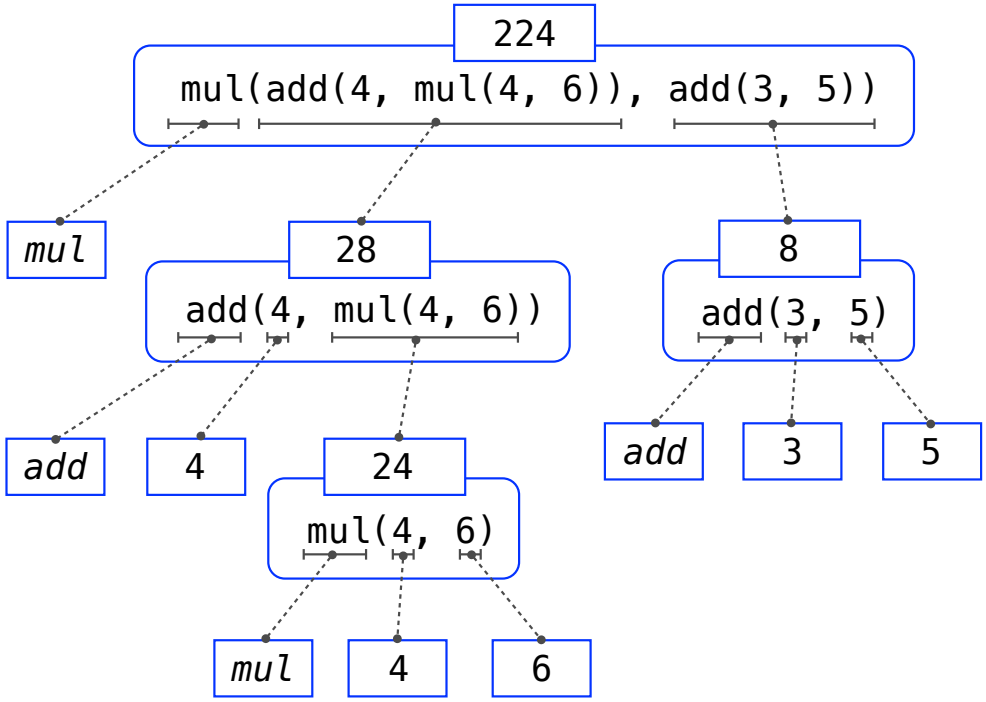

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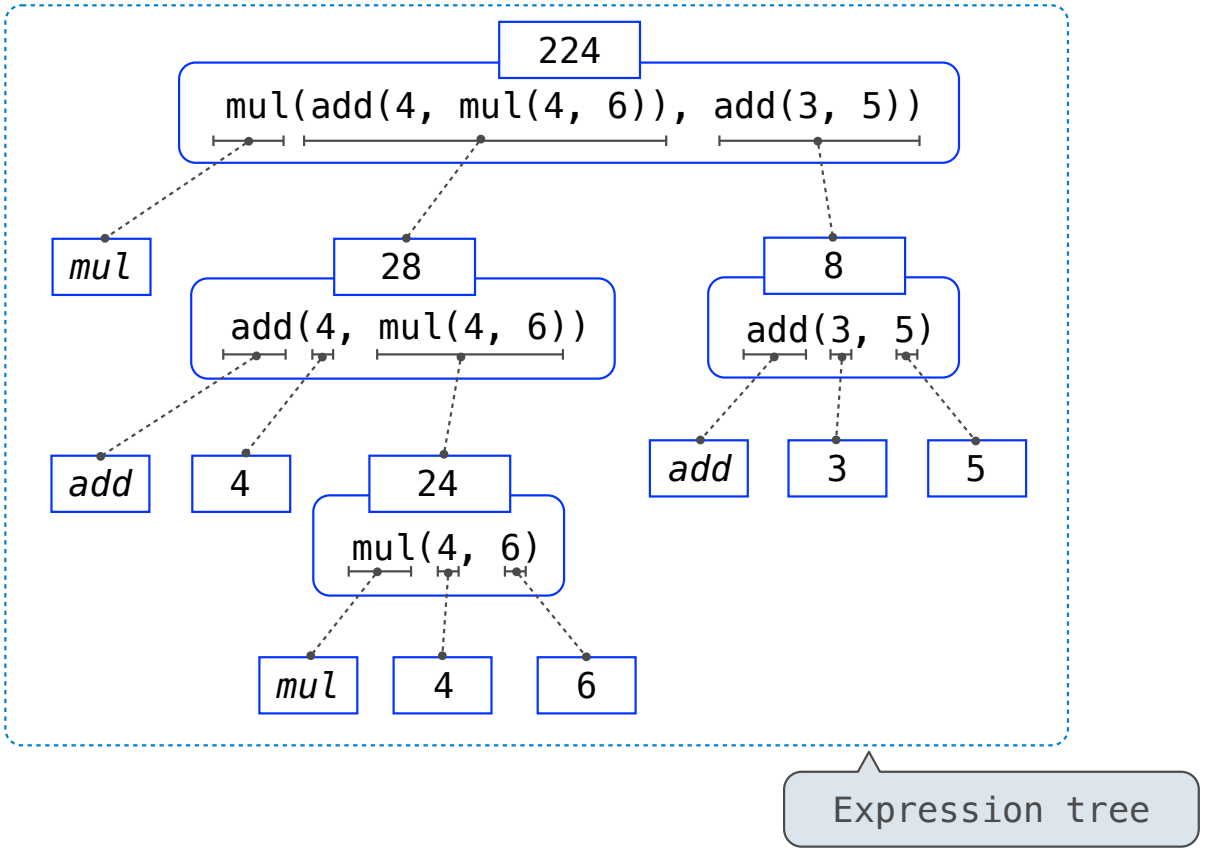

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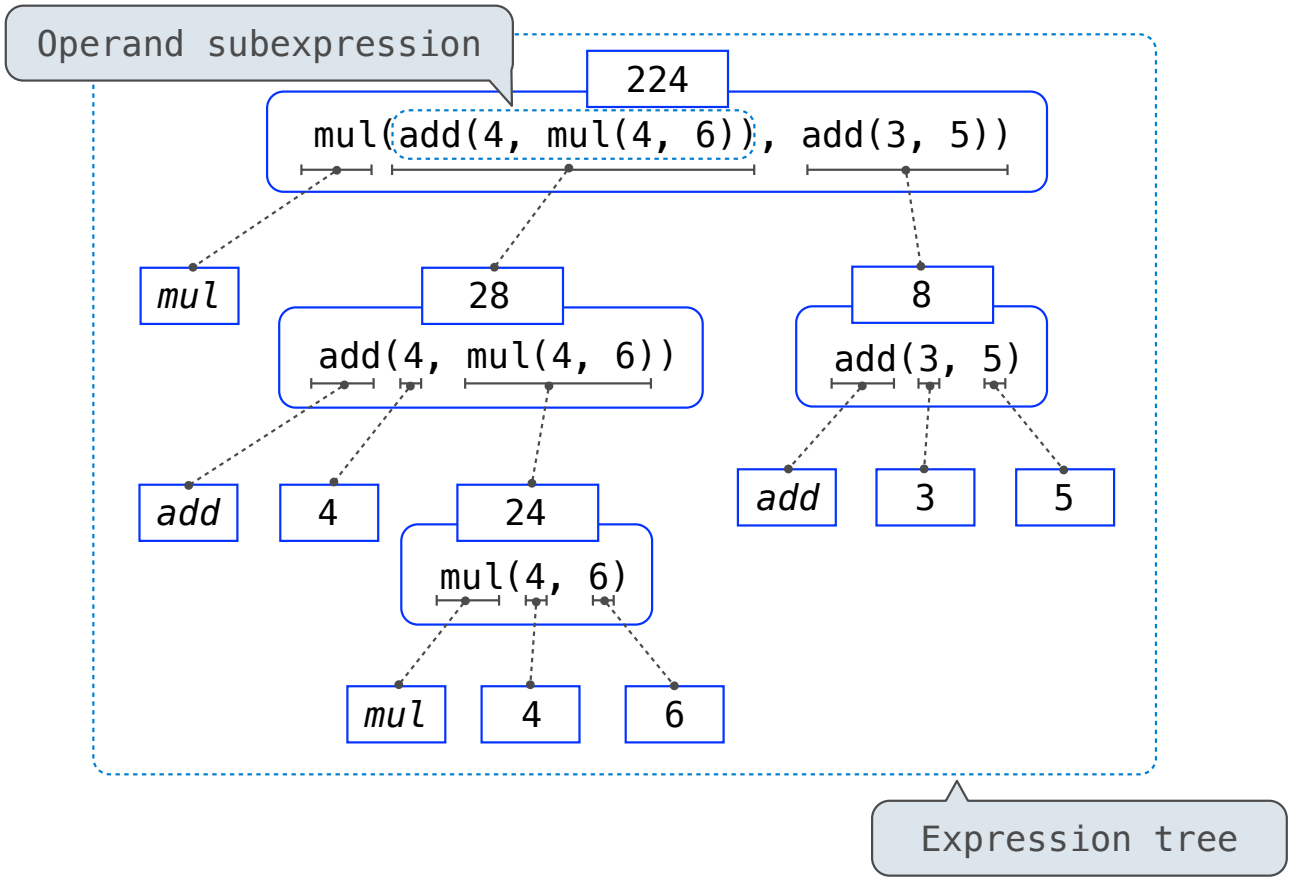

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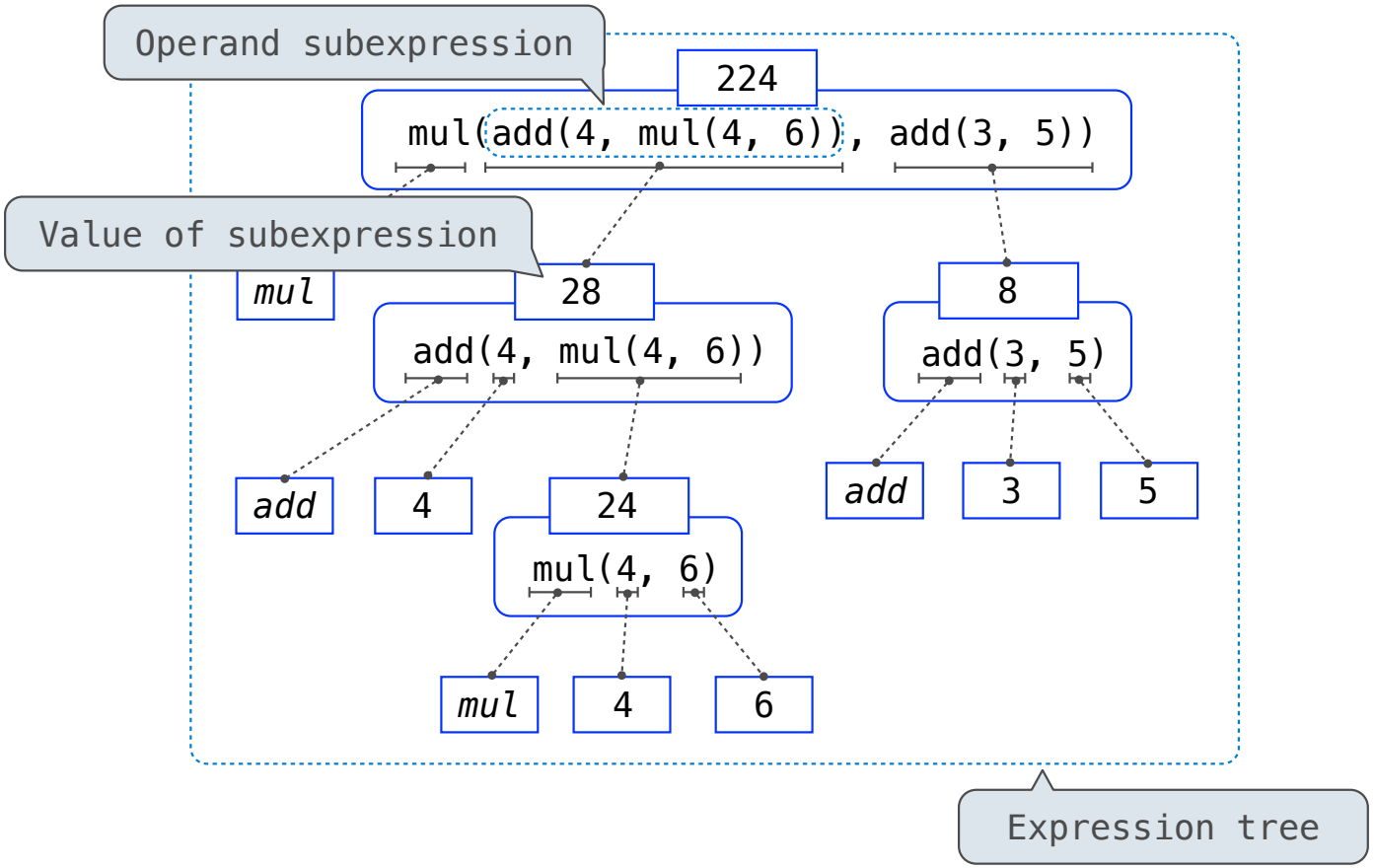

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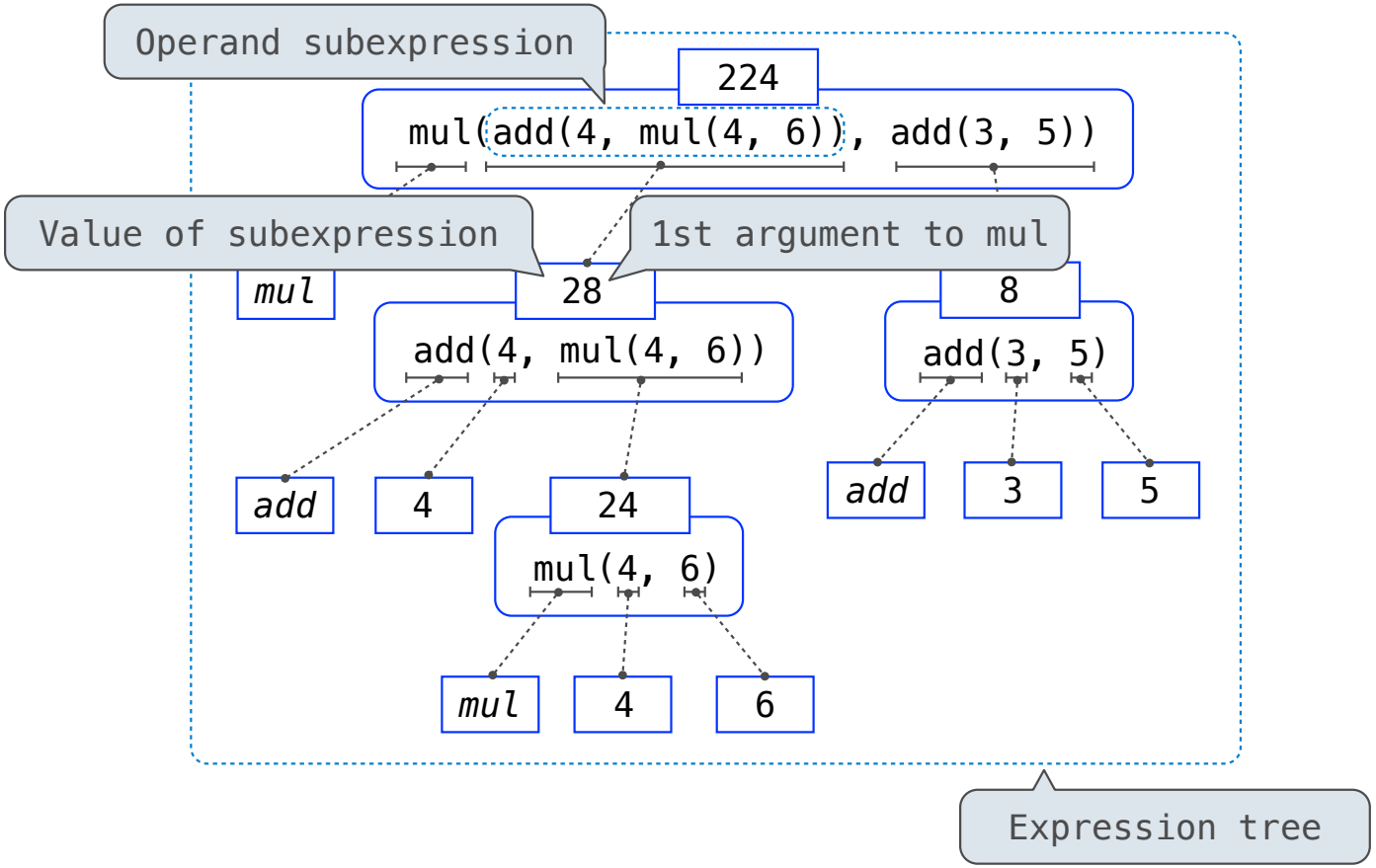

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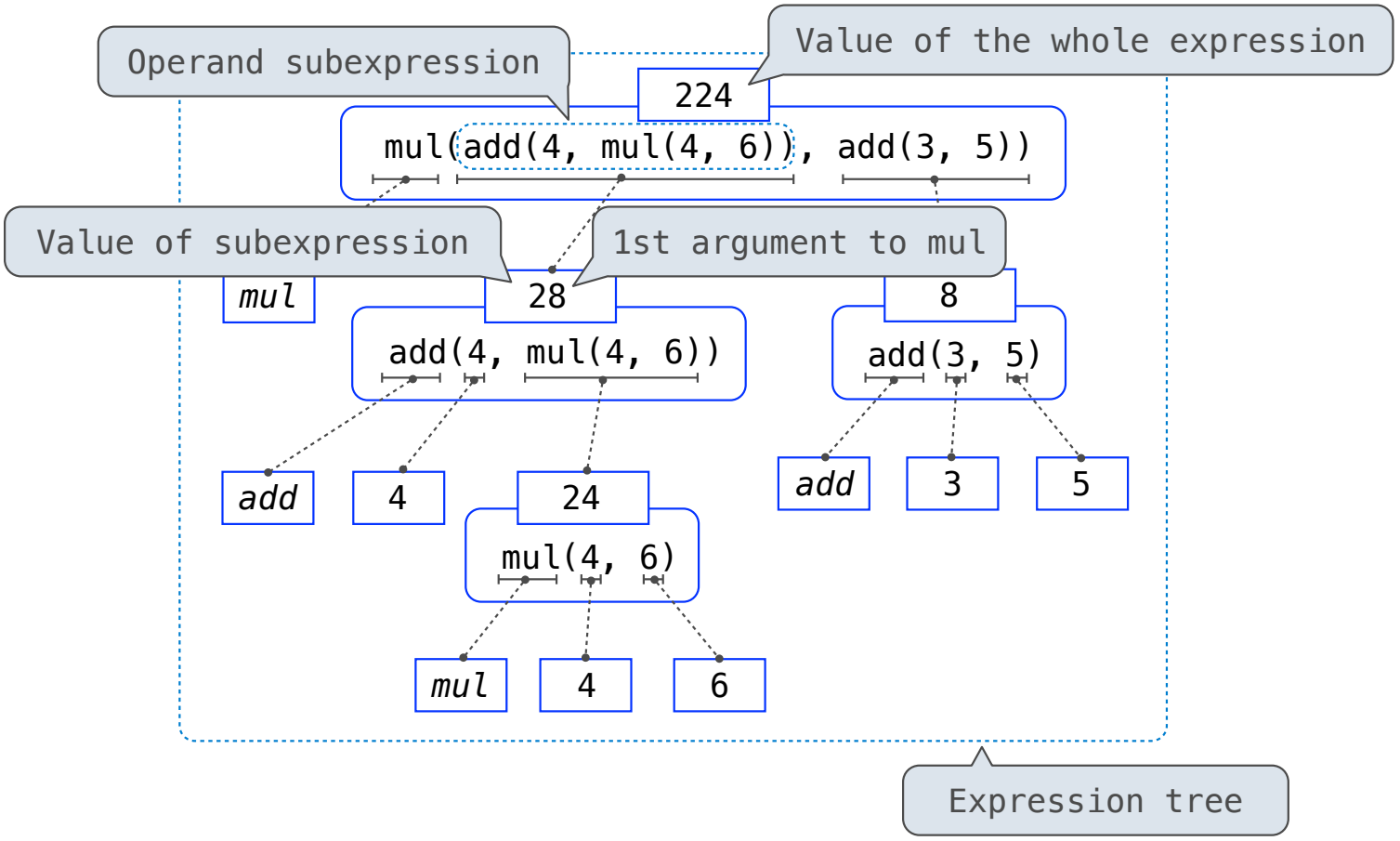


Names, Assignment, and User-Defined Functions

(Demo)

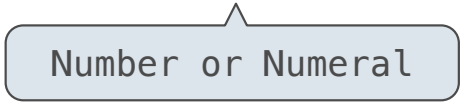
Types of Expressions

Types of Expressions

Primitive expressions:

Types of Expressions

Primitive expressions: 2



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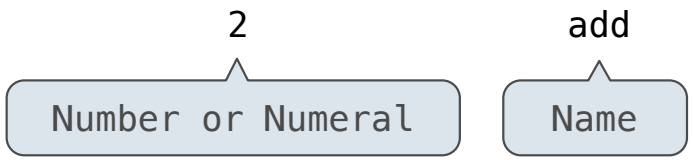

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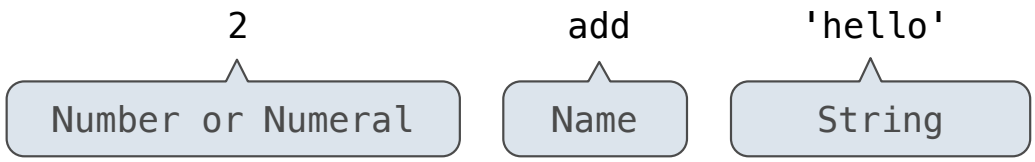

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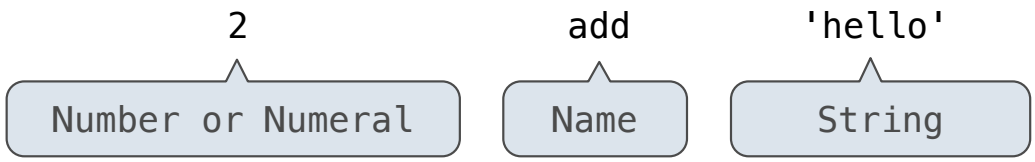

Call expressions:

Types of Expressions

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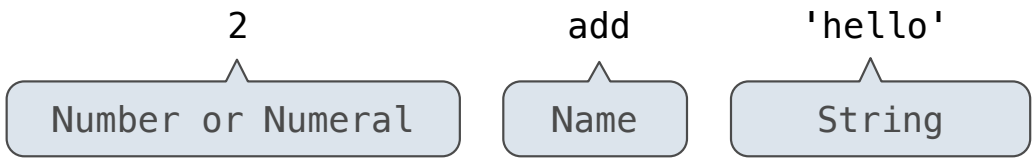

Call expressions:

```
max ( 2 , 3 )
```

Types of Expressions

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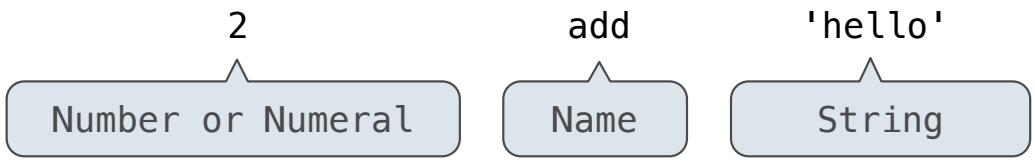

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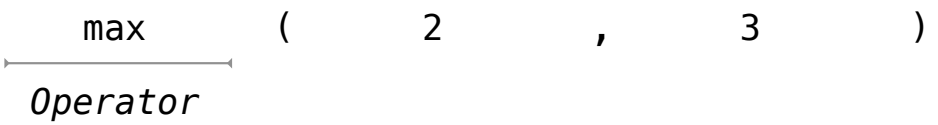

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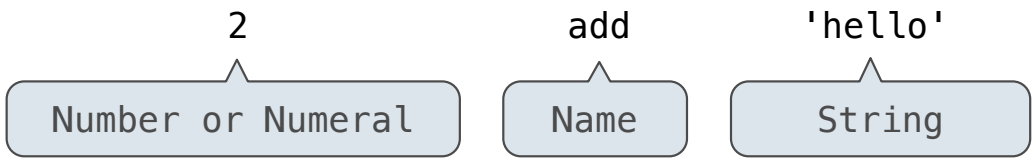

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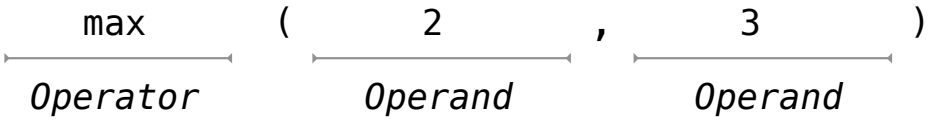

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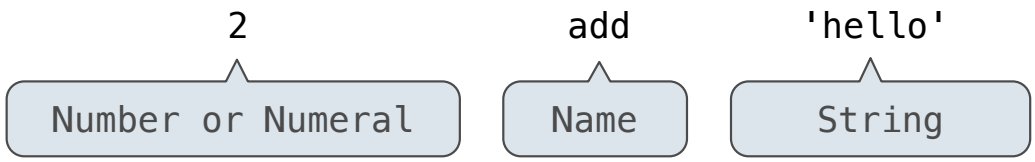

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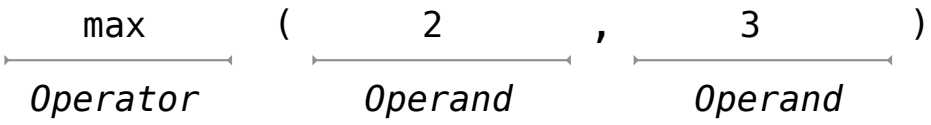
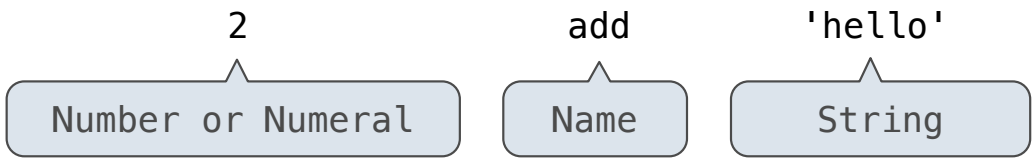



```
max(min(pow(3, 5), -4), min(1, -2))
```

Types of Expressions

Primitive expressions:



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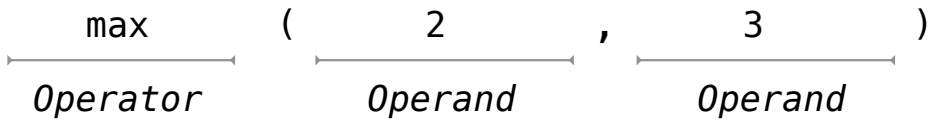

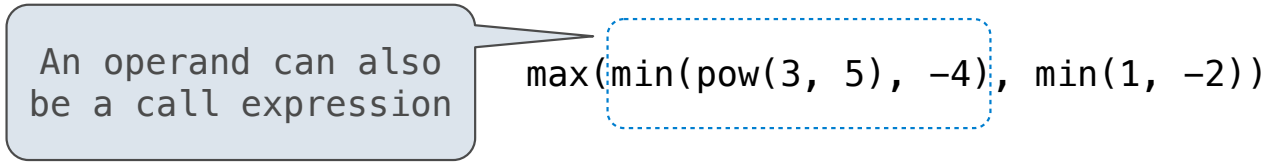

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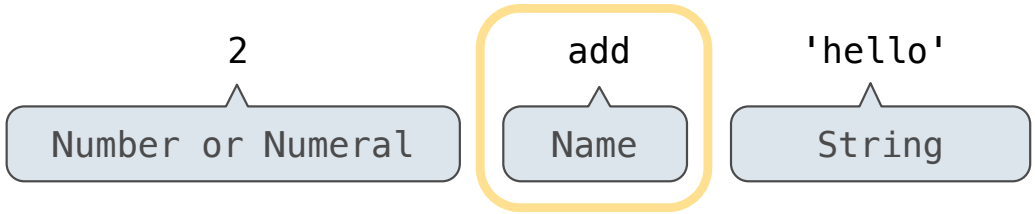

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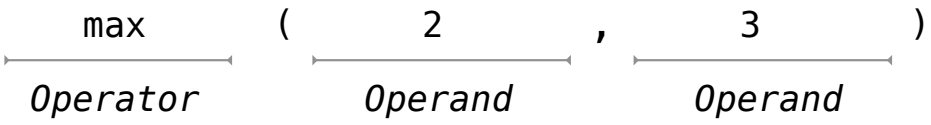

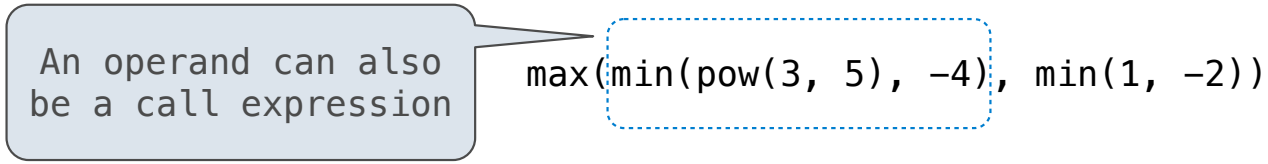

Discussion Question 1

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What is the value of the final expression in this sequence?

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```
>>> f = min
```

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```
>>> f = min
>>> f = max
```

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```
>>> f = min
>>> f = max
>>> g, h = min, max
```

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```
>>> f = min
>>> f = max
>>> g, h = min, max
>>> max = g
```

Discussion Question 1

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```
>>> f = min
>>> f = max
>>> g, h = min, max
>>> max = g
>>> max(f(2, g(h(1, 5), 3)), 4)
```

Discussion Question 1

What is the value of the final expression in this sequence?

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???

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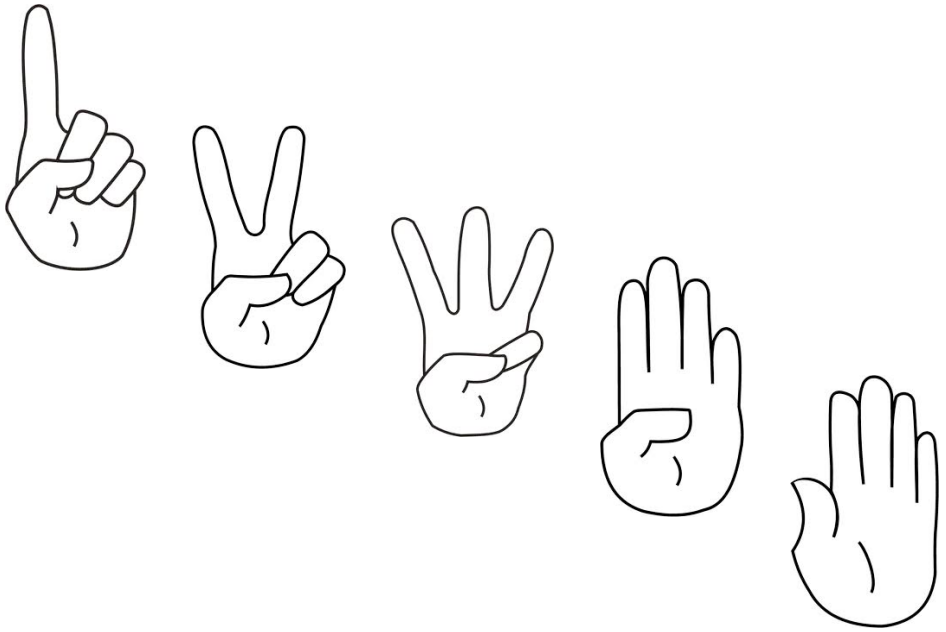

Environment Diagrams

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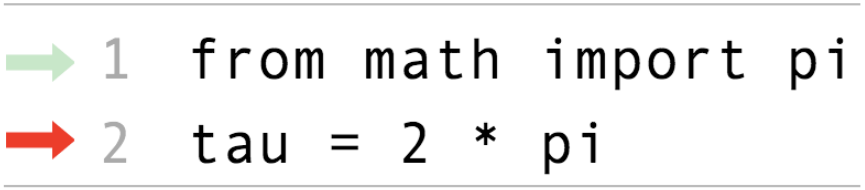

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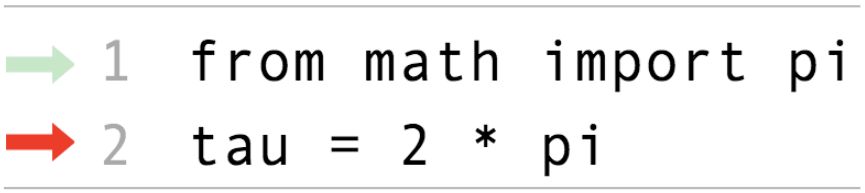

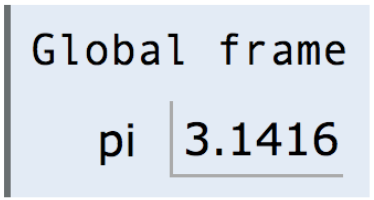

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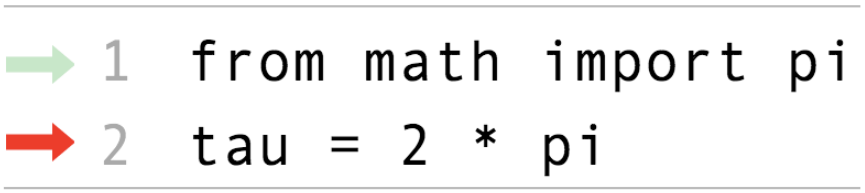

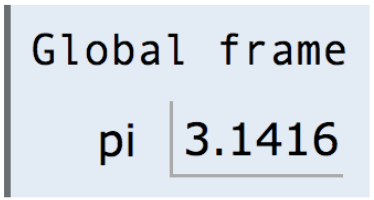

Code (left): **Frames (right):**

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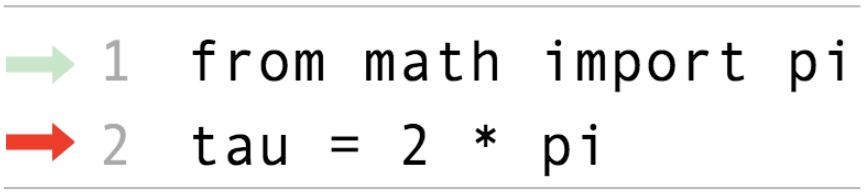

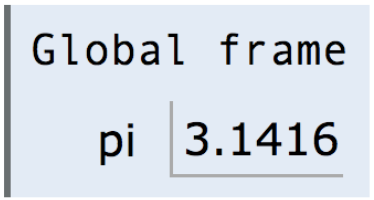

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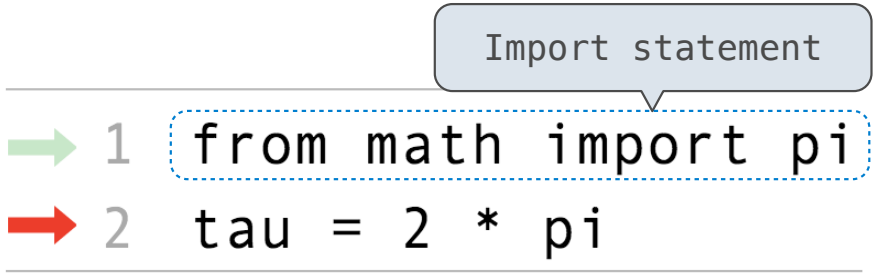

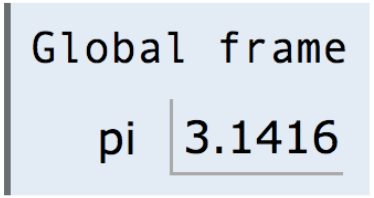

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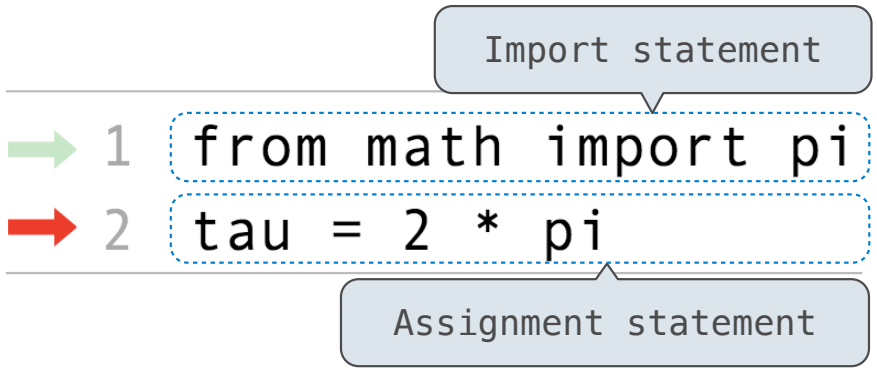

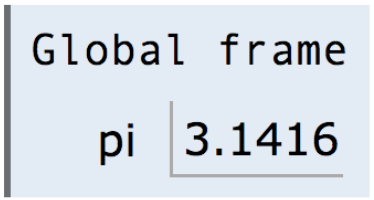

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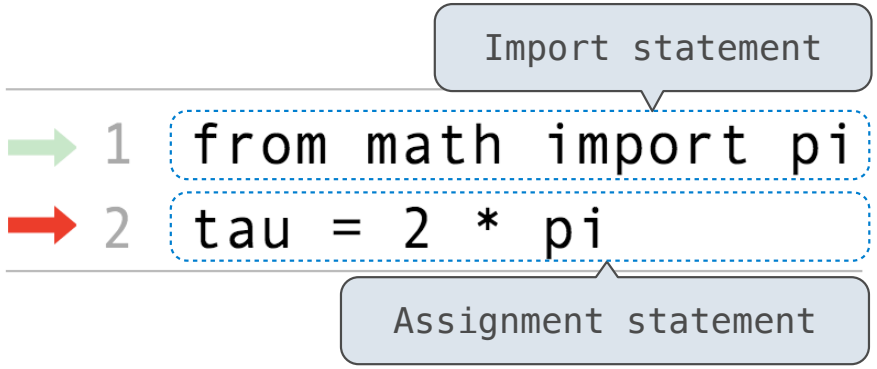

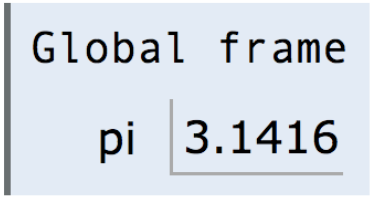

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Statements and expressions

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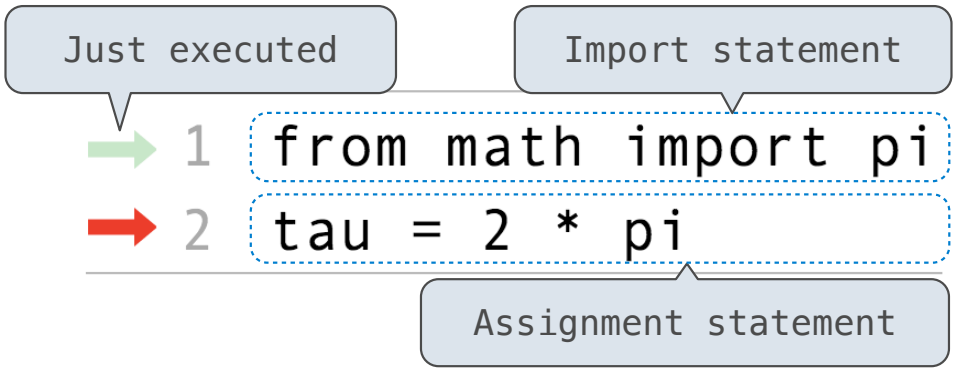

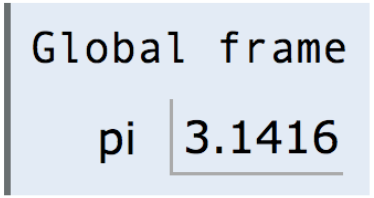

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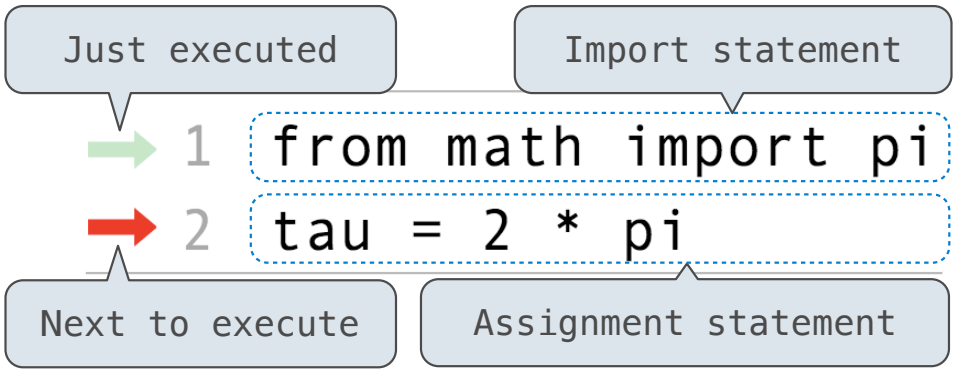

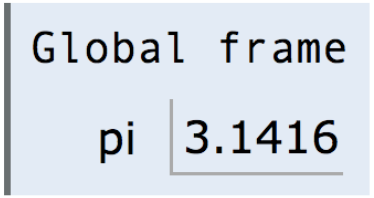

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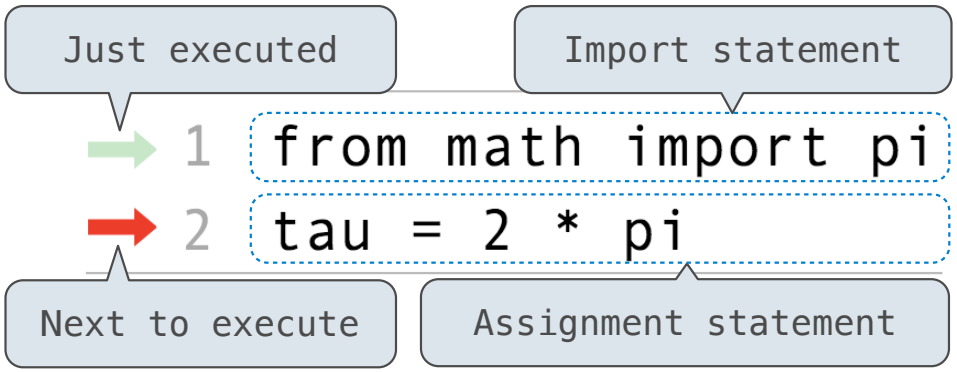

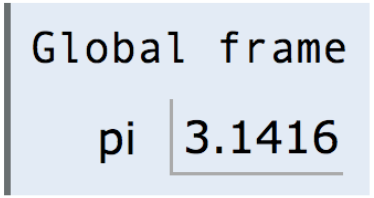

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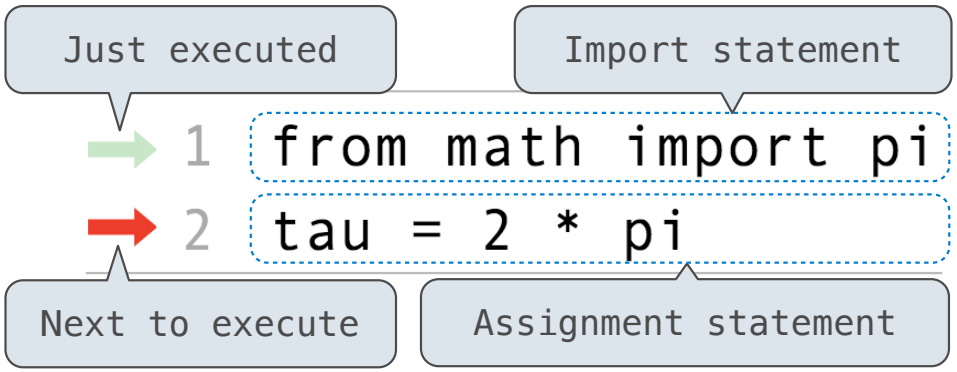

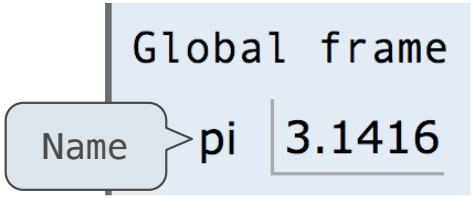

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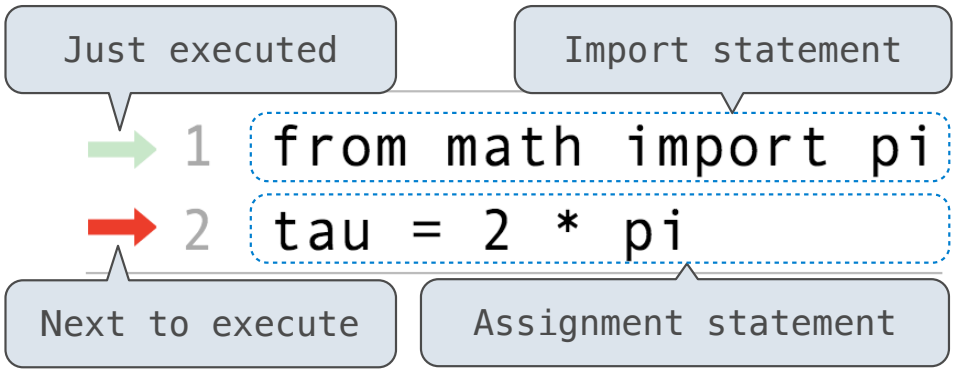

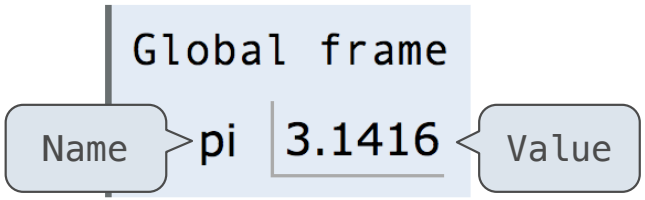

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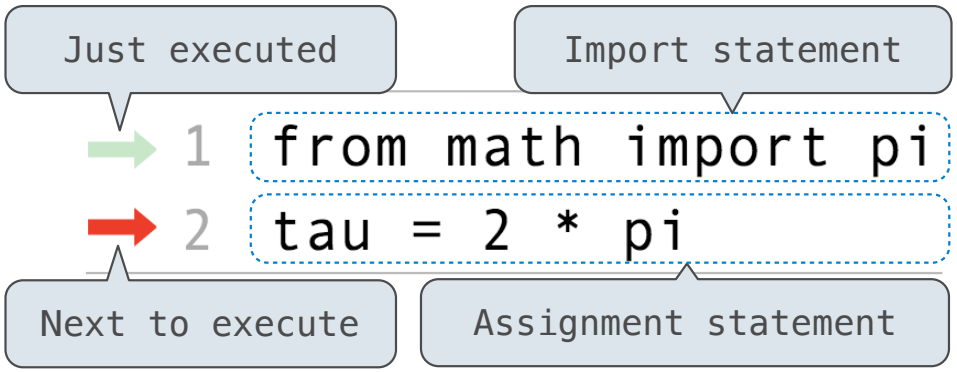

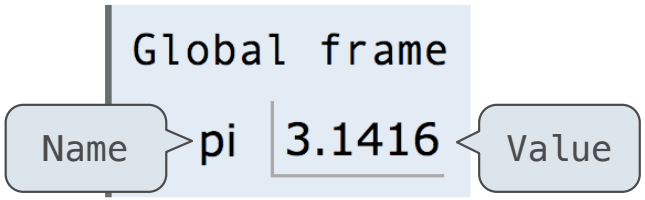

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Frames (right):

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Within a frame, a name cannot be repeated

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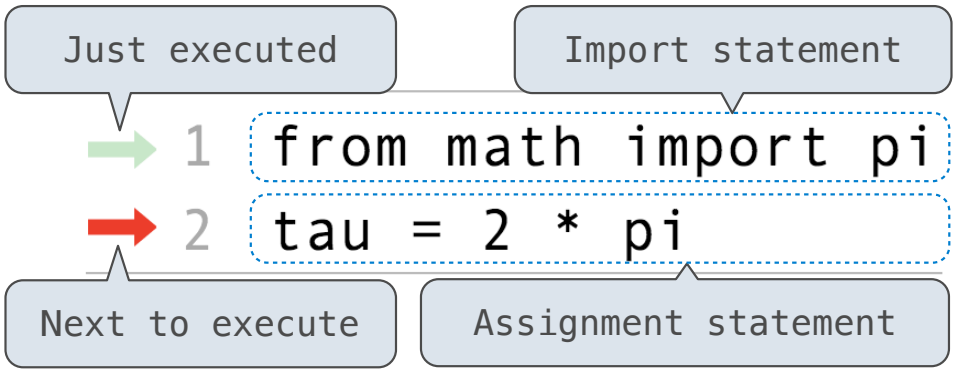

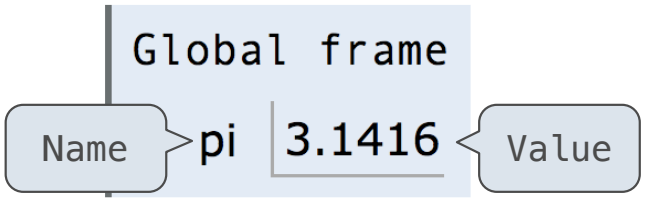

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(Demo)

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Assignment Statements

http://pythontutor.com/composingprograms.html#code=a%20%3D%201%0Ab%20%3D%202%0Ab,%20a%20%3D%20a%20%2B%20b,%20b&cumulative=false&curInstr=0&mode=display&origin=composingprograms.js&py=3&rawInputLstJSON=%5B%5D

Assignment Statements

```
1  a = 1
2  b = 2
3  b, a = a + b, b
```


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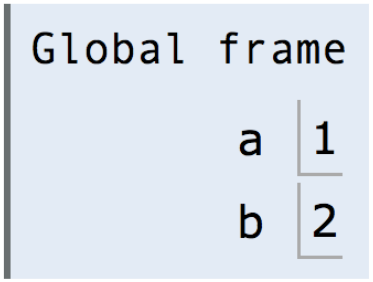

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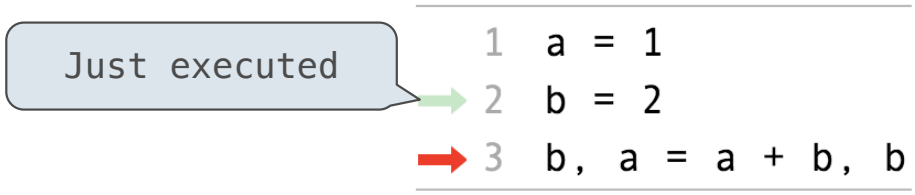

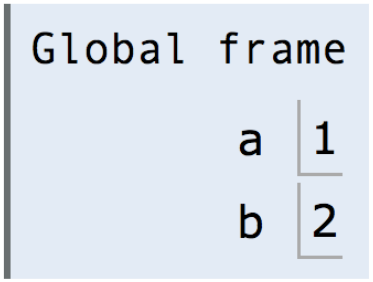

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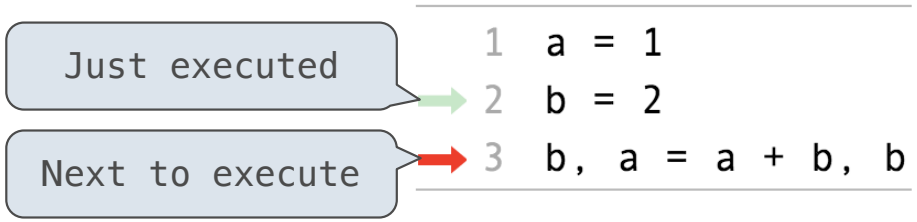

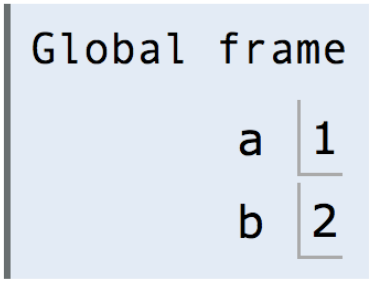

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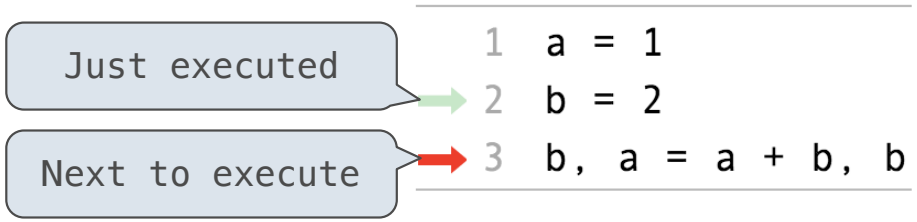

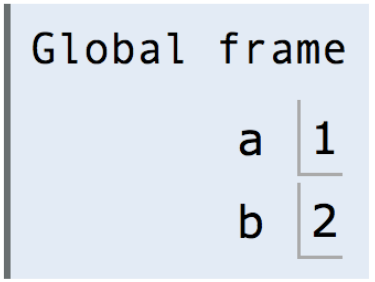

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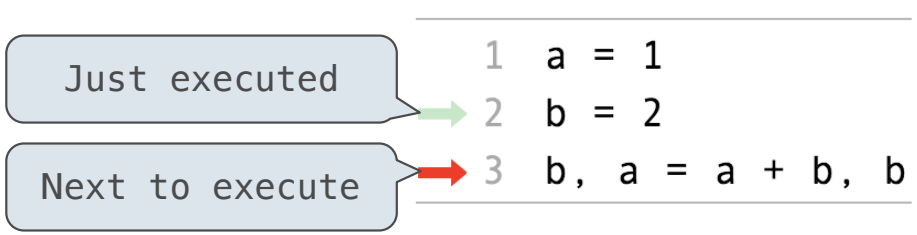

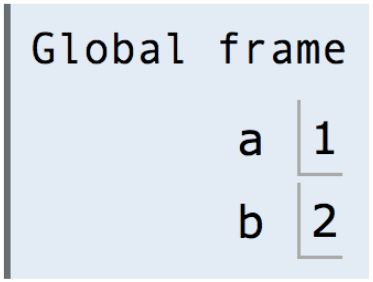

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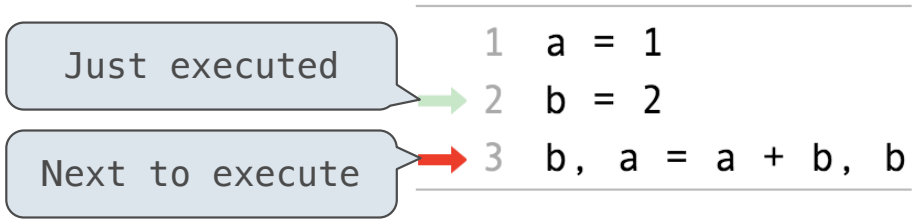

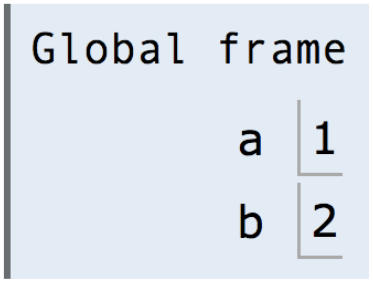

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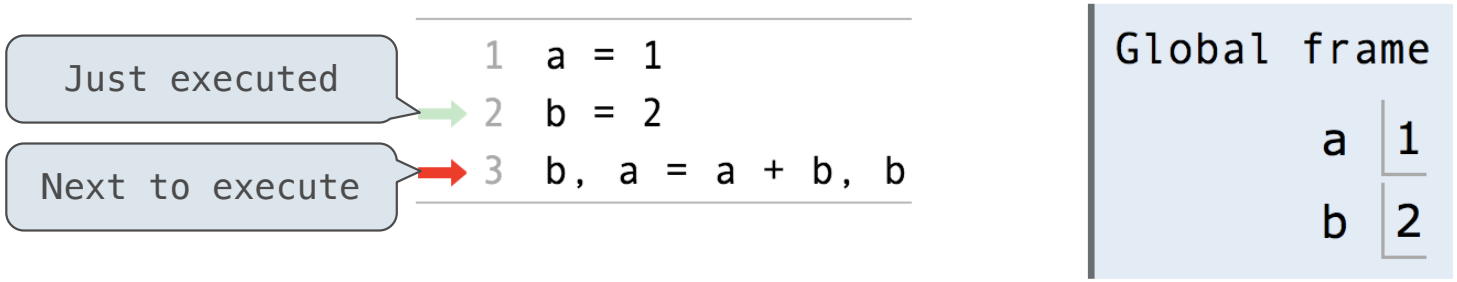

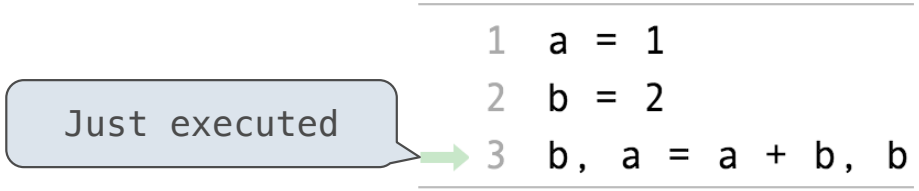

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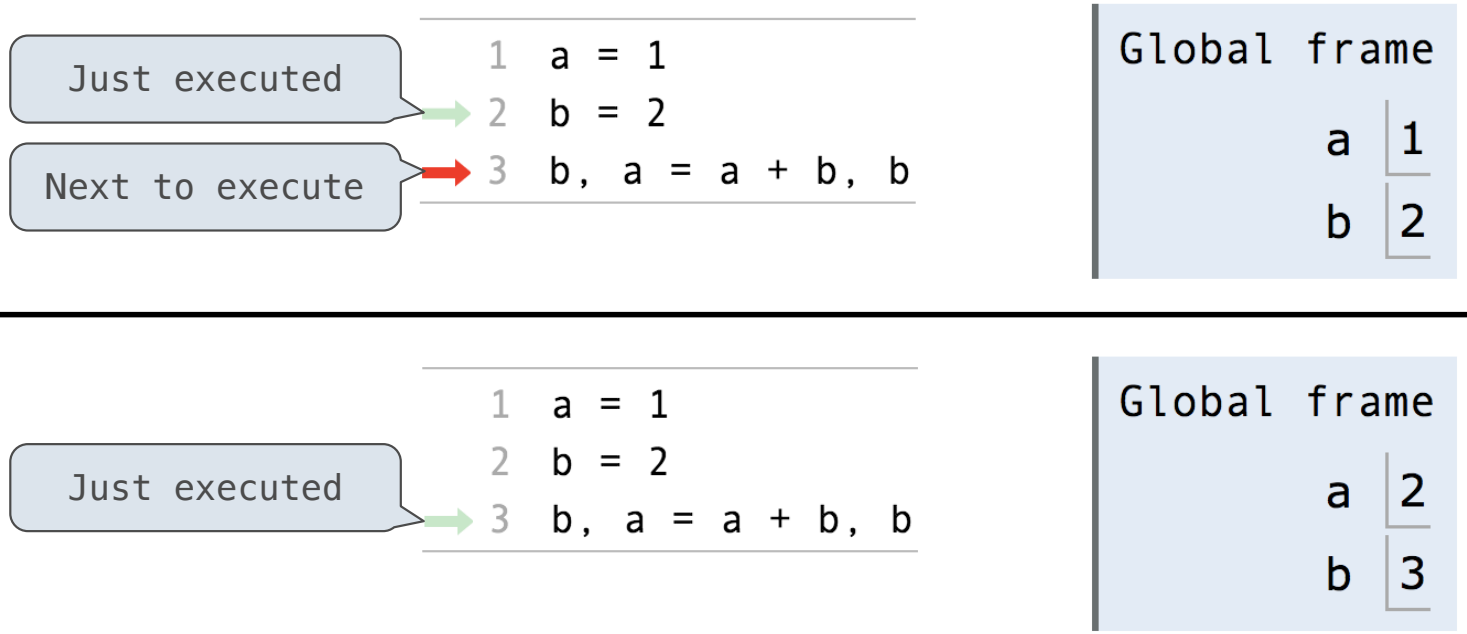

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Discussion Question 1 Solution

(Demo)

http://pythontutor.com/composingprograms.html#code=f%20%3D%20min%0Af%20%3D%20max%0Ag,%20h%20%3D%20min,%20max%0Amax%20%3D%20g%0Amax%28f%282,%20g%28h%281,%205%29,%203%29%29,%204%29&cumulative=false&curInstr=0&mode=display&origin=composingprograms.js&py=3&rawInputLstJSON=%5B%5D

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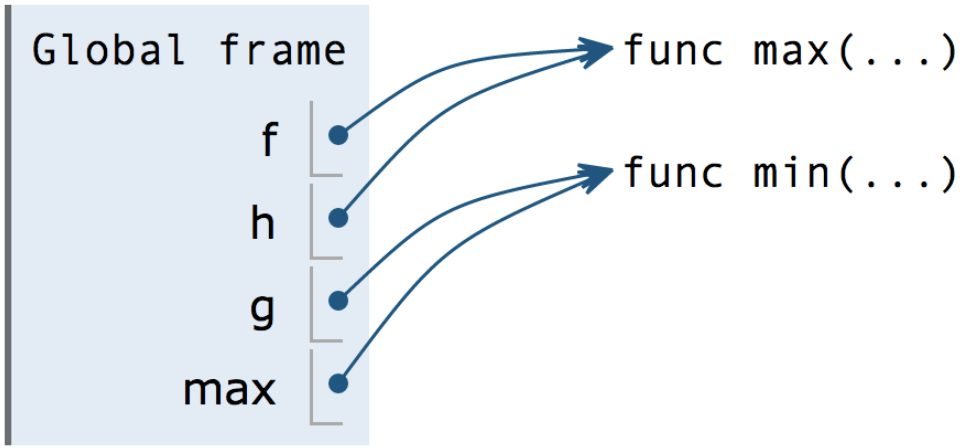

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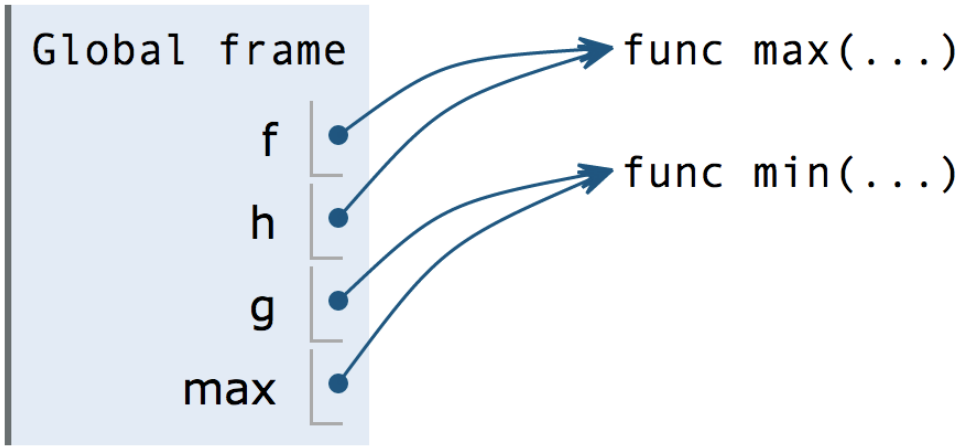

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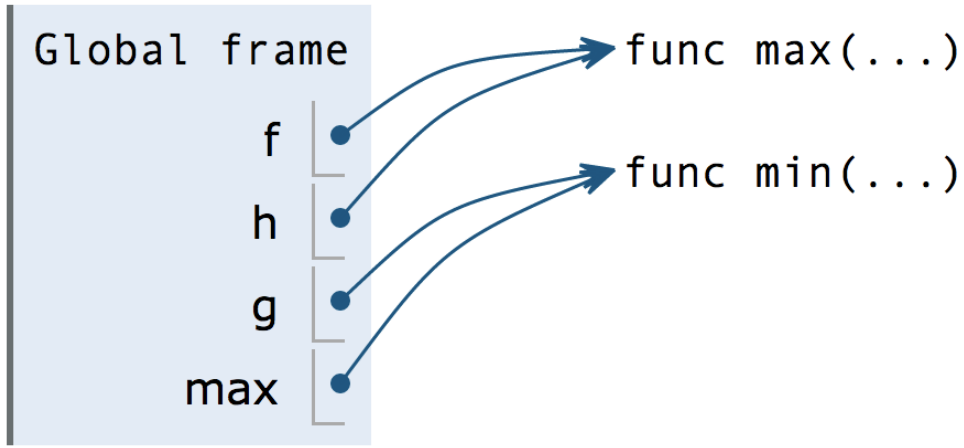

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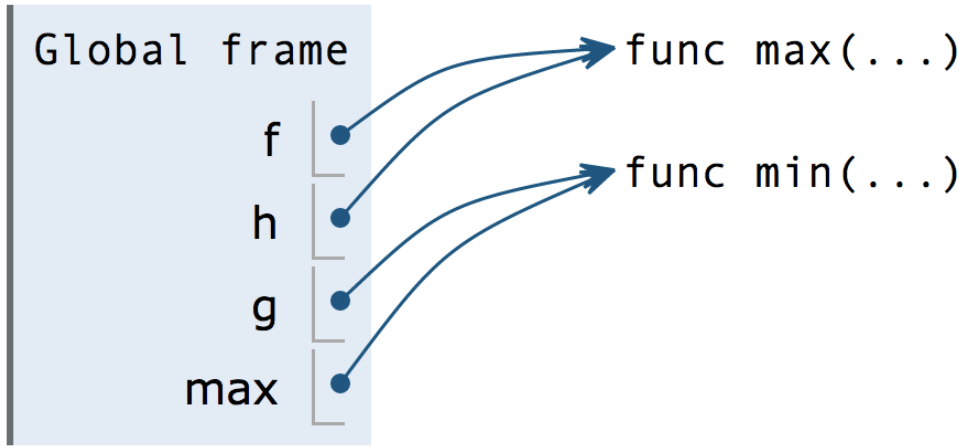

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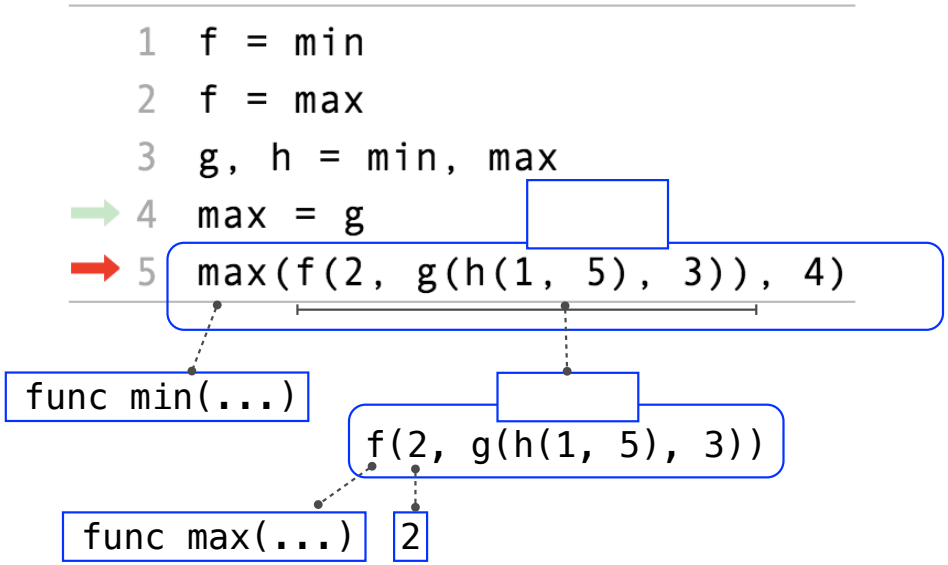

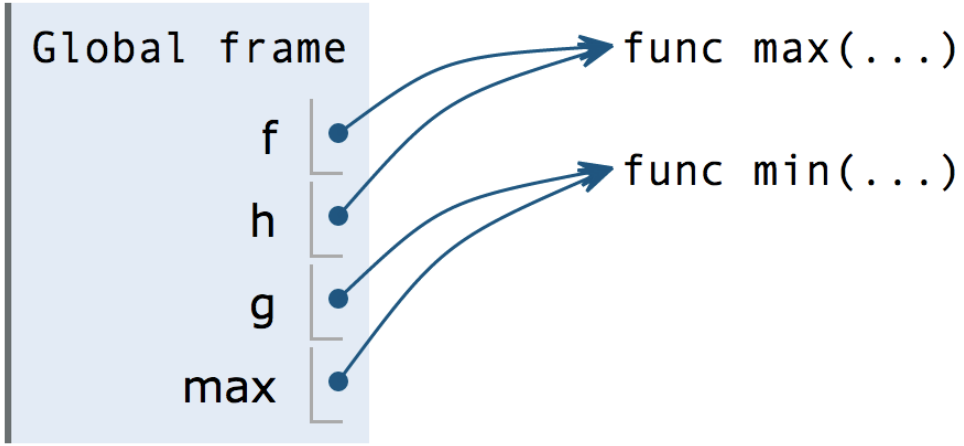

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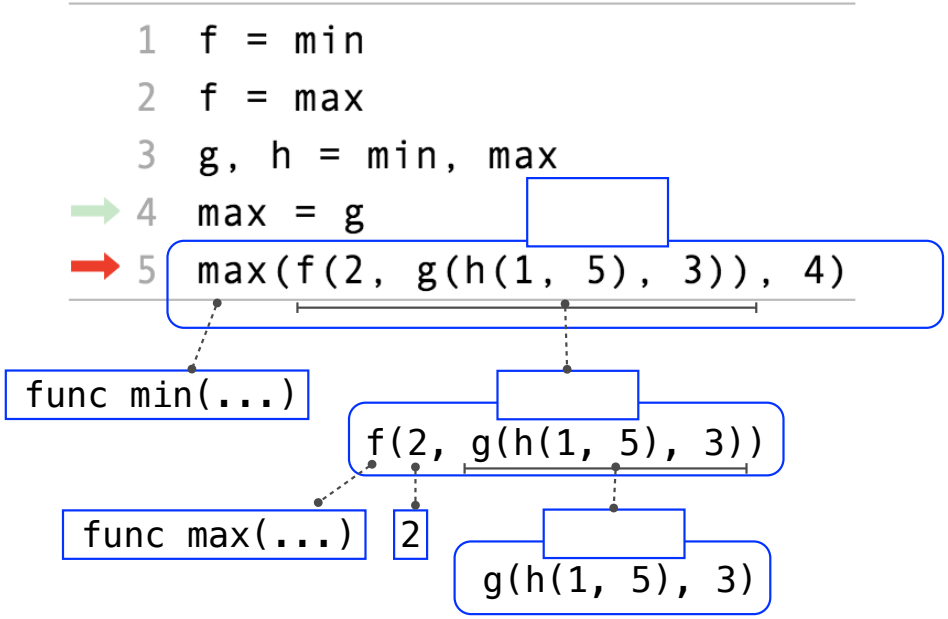

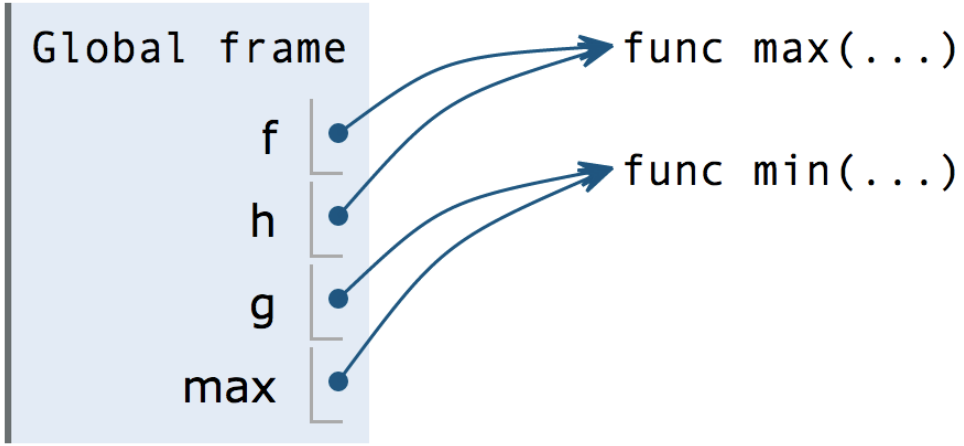

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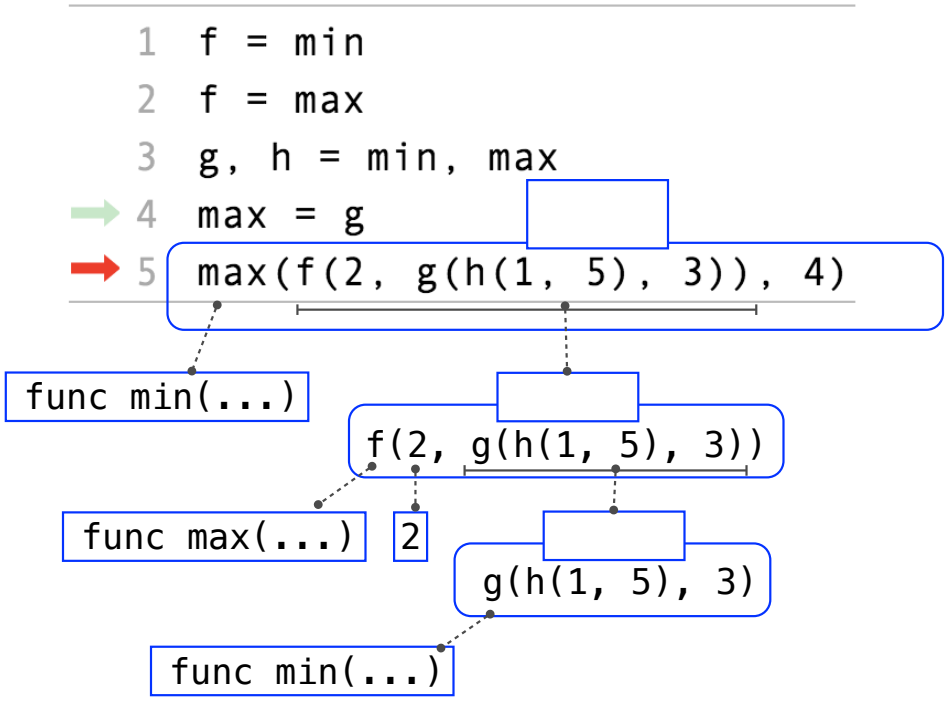

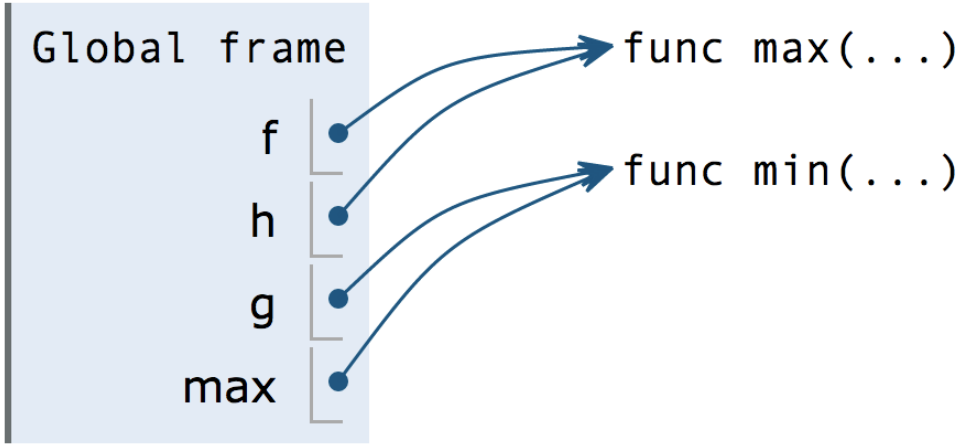

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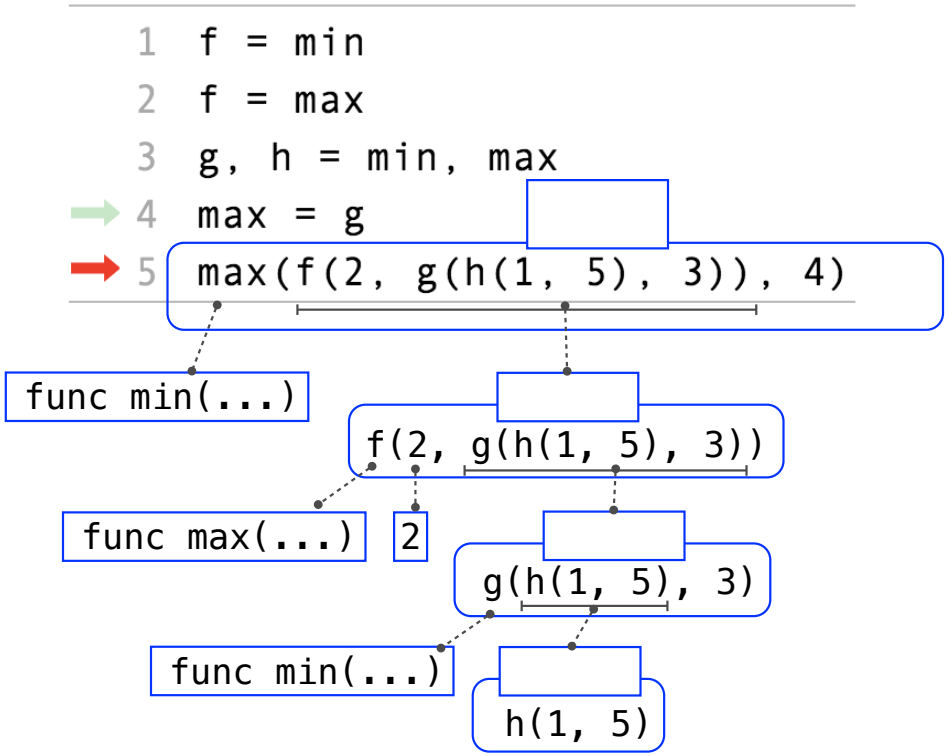

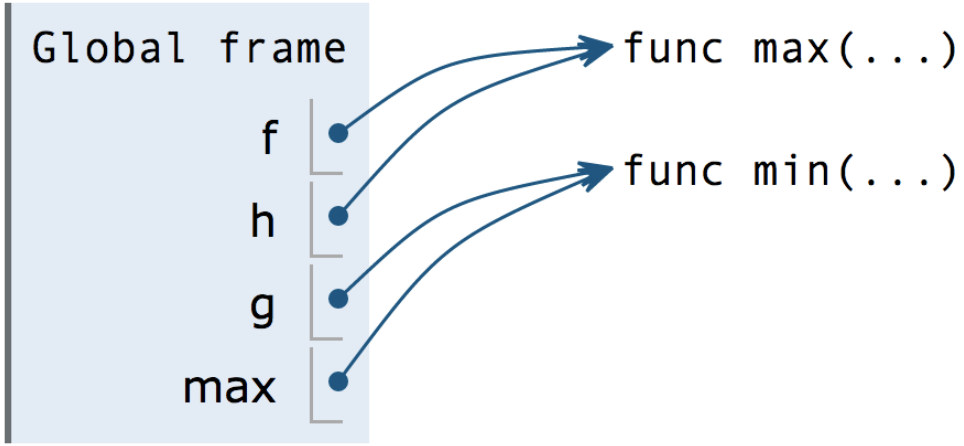

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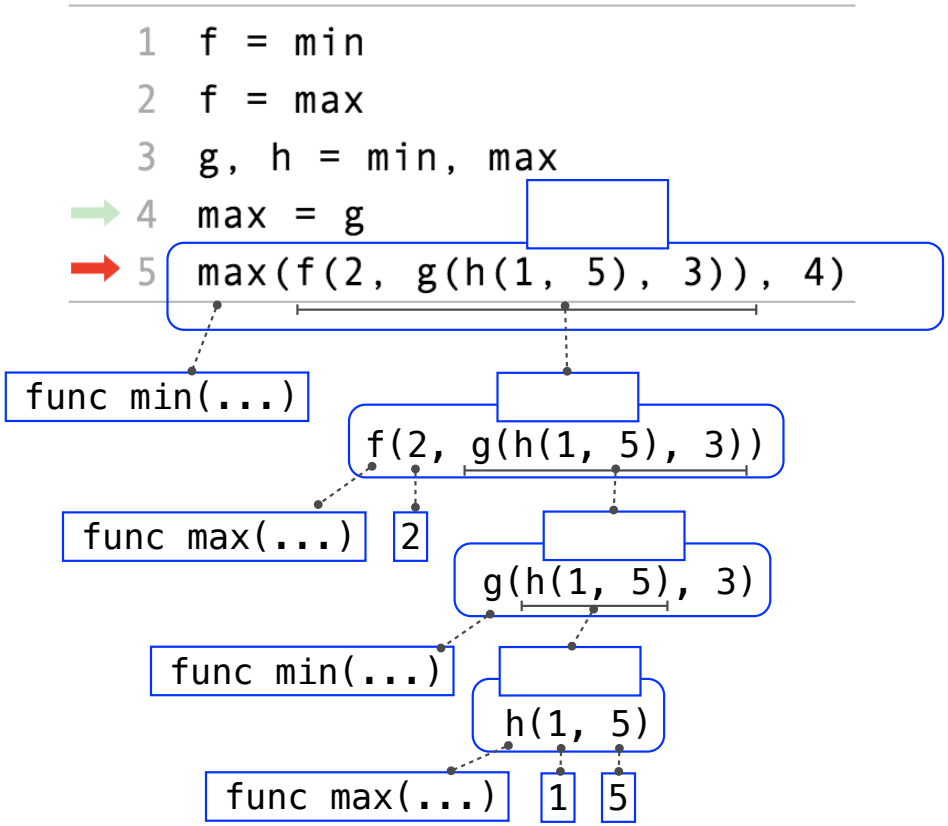

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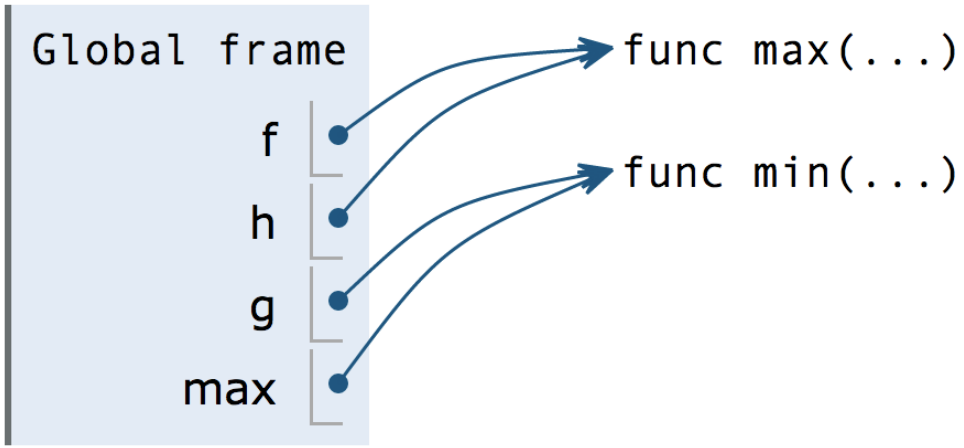

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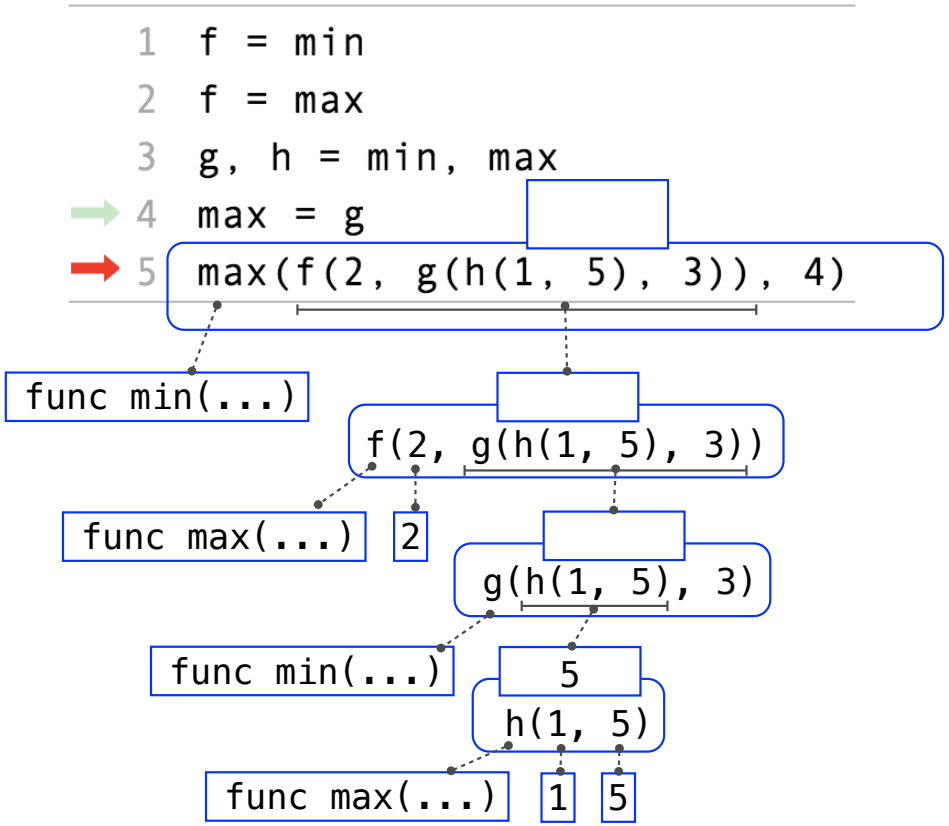

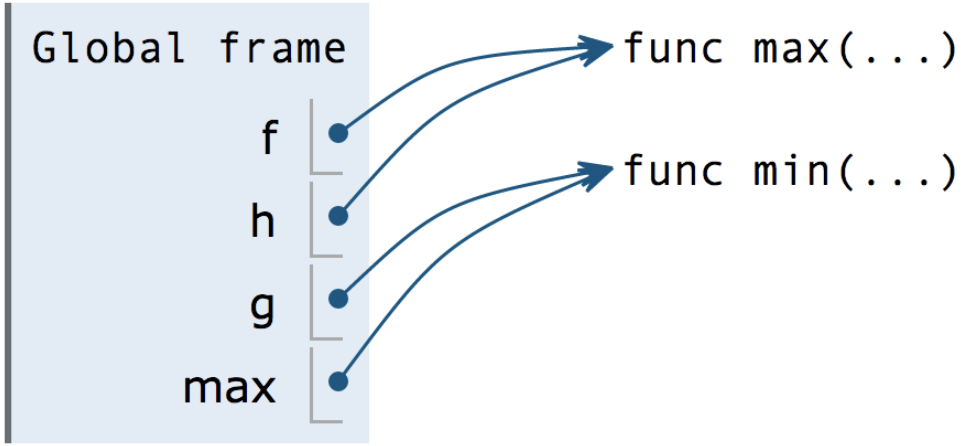

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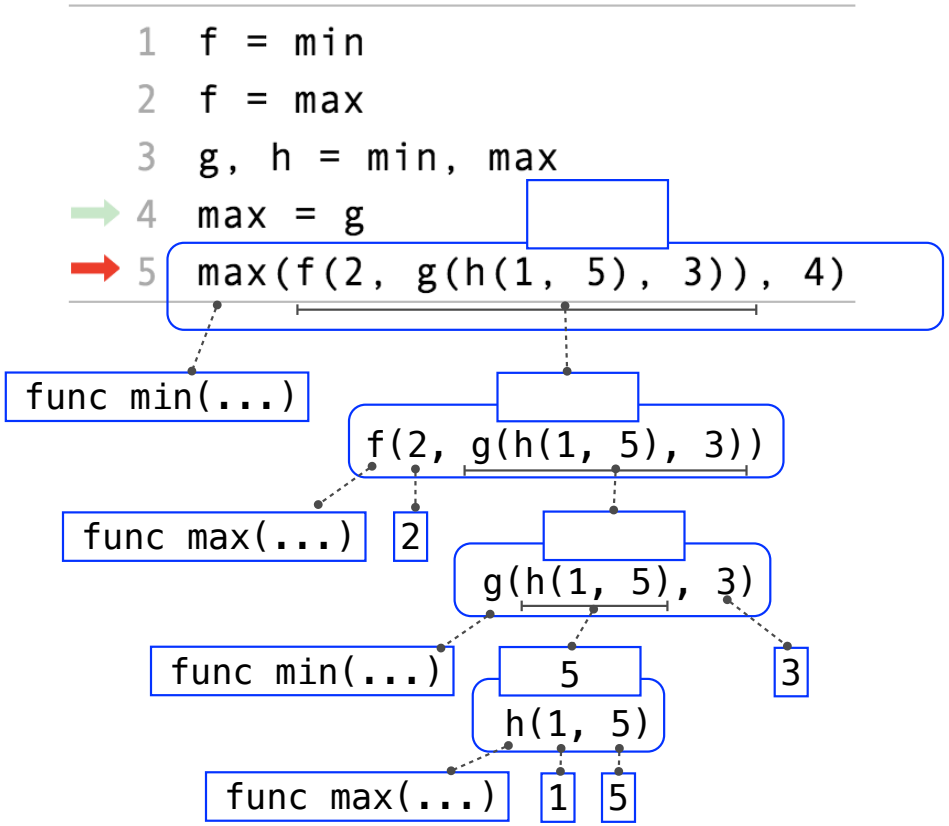

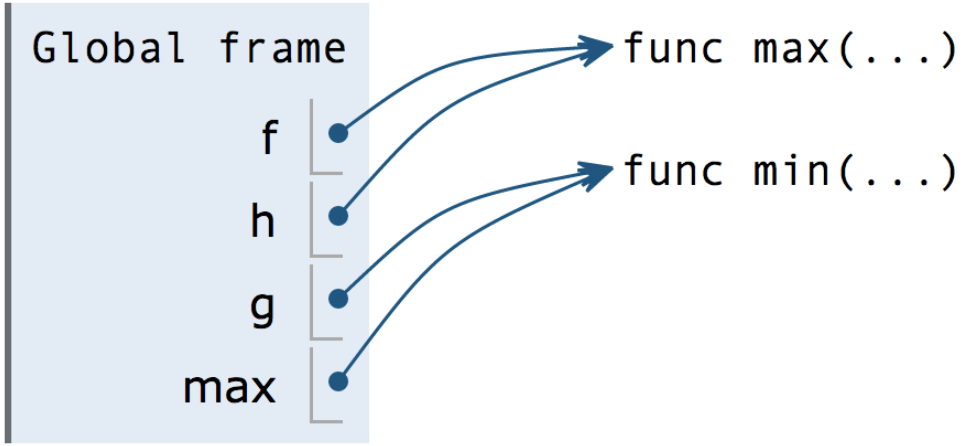

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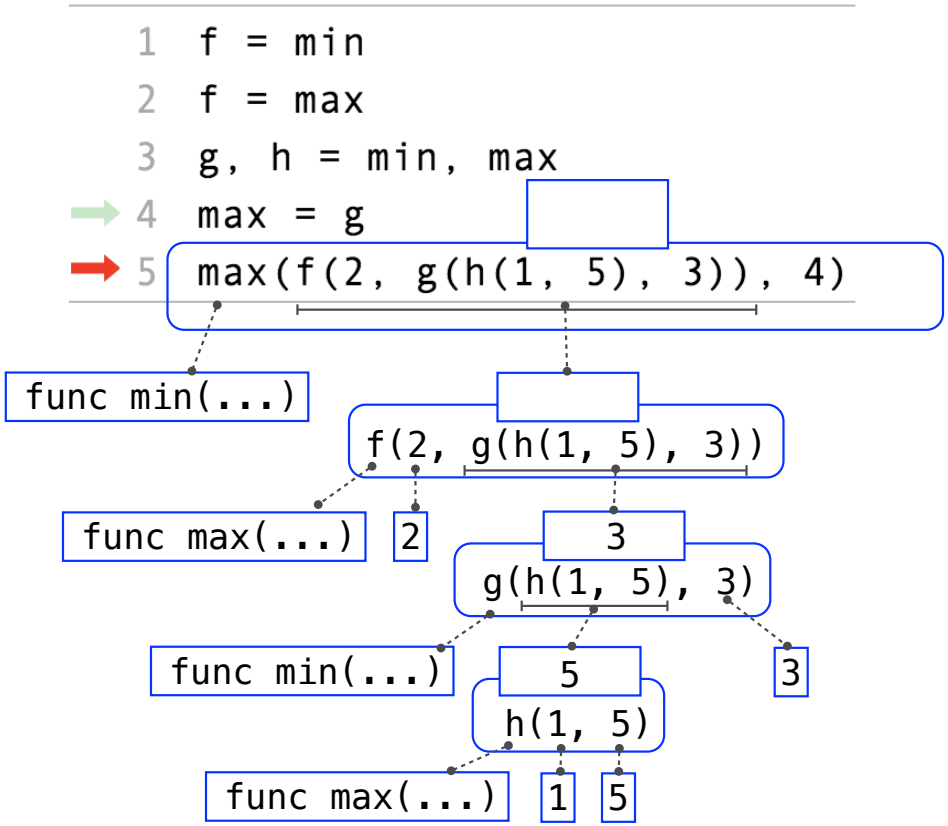

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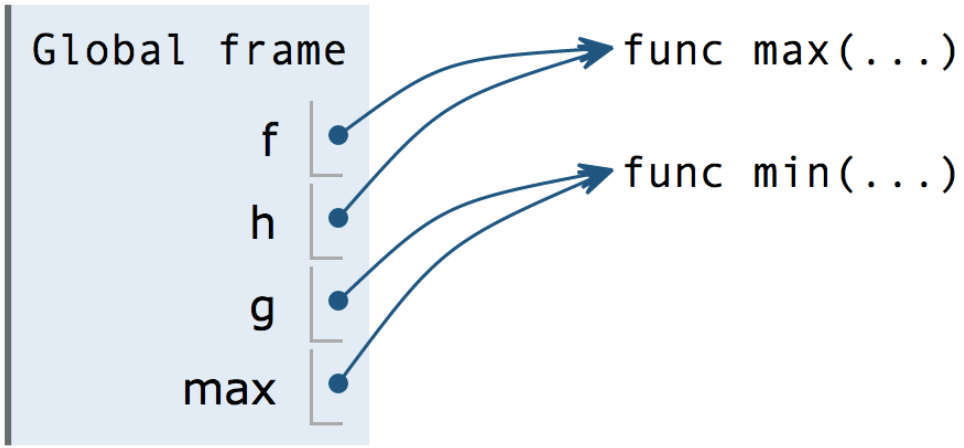

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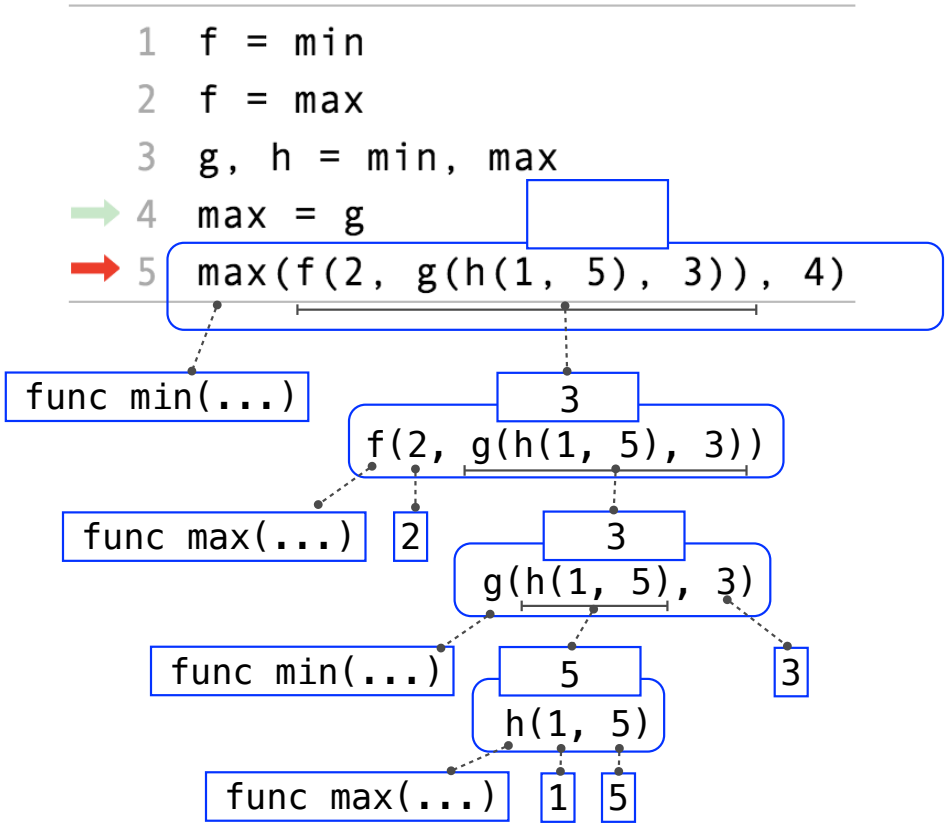

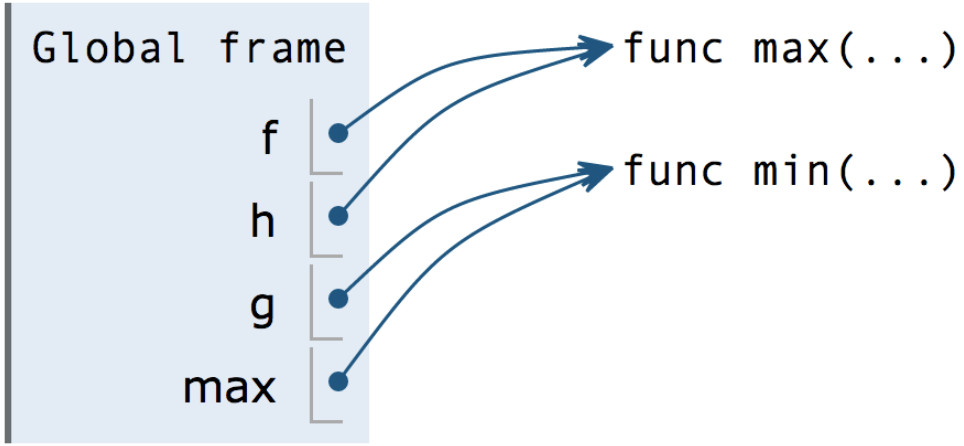

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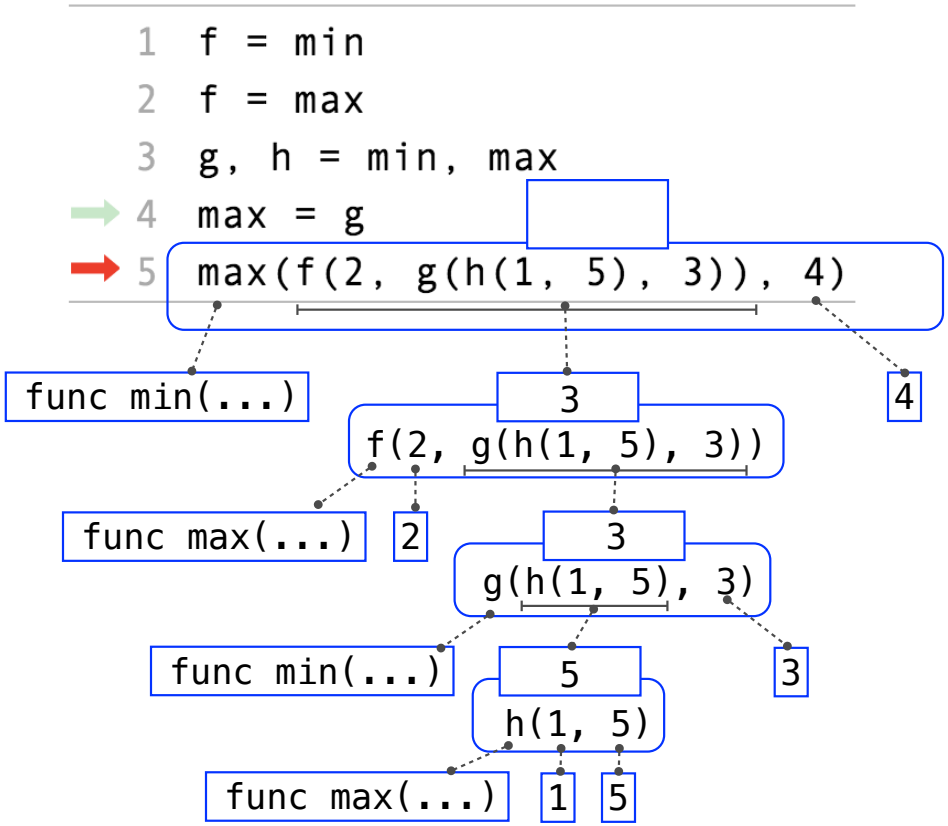

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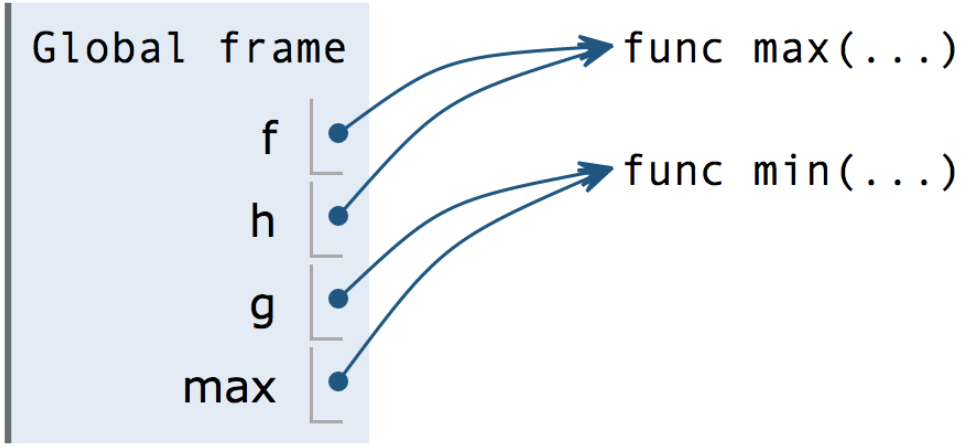

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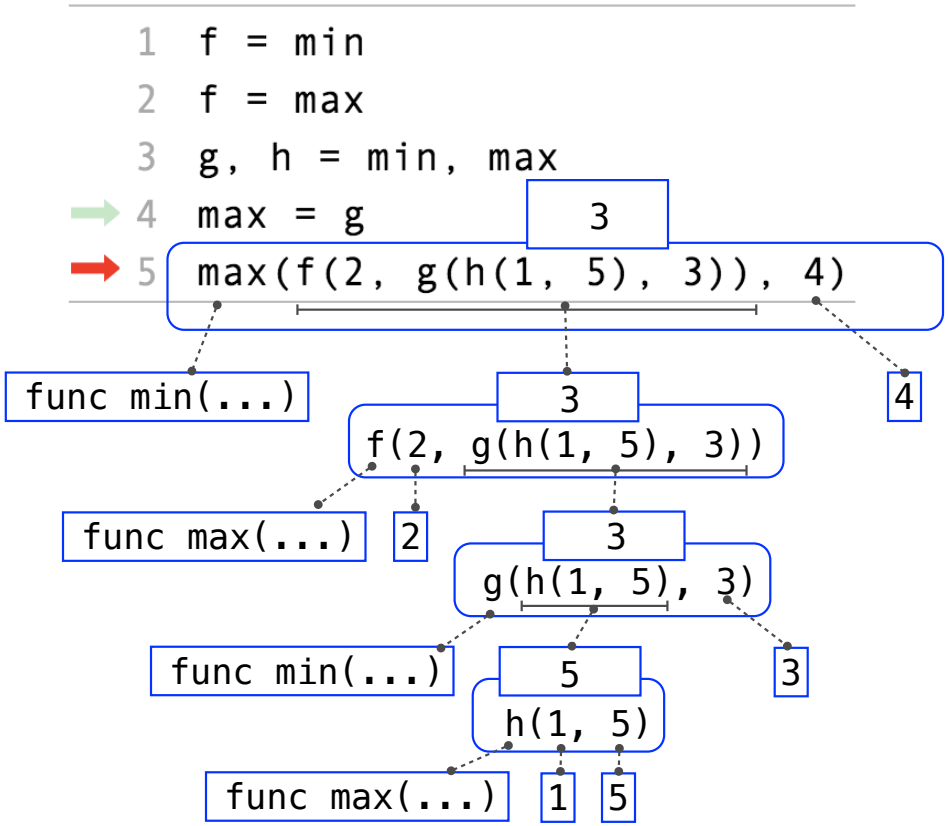

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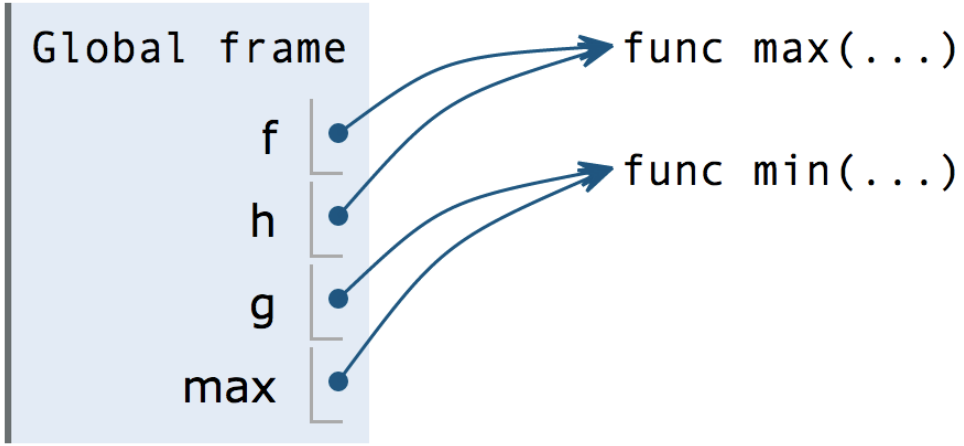

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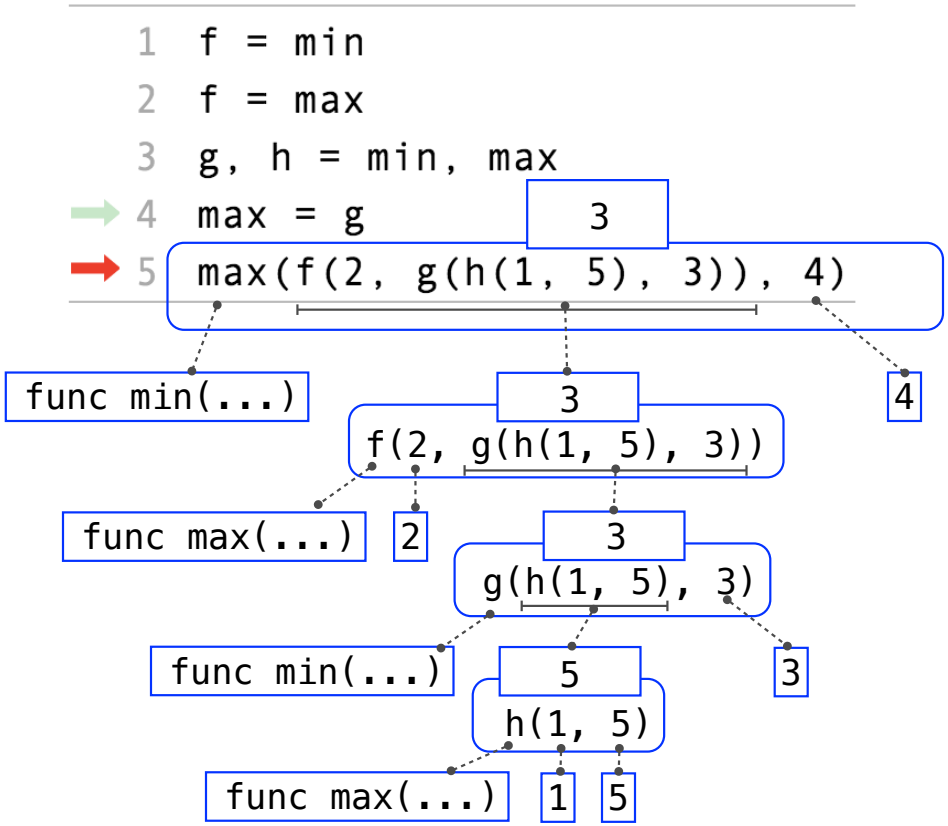

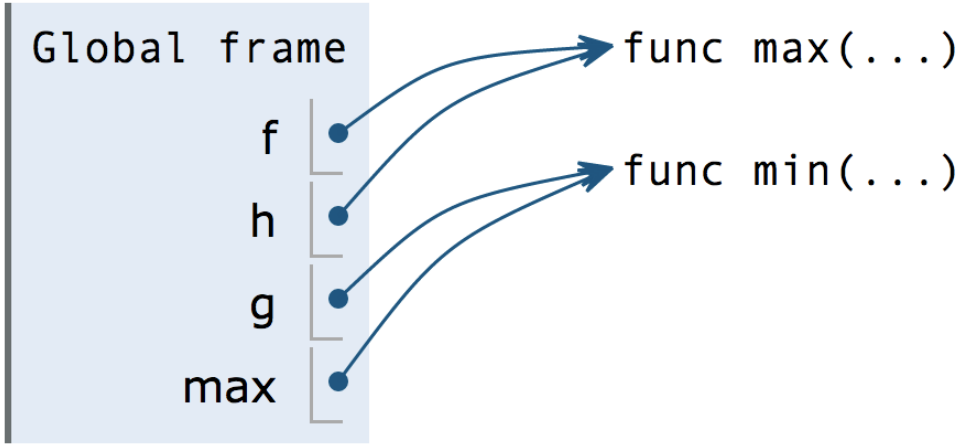

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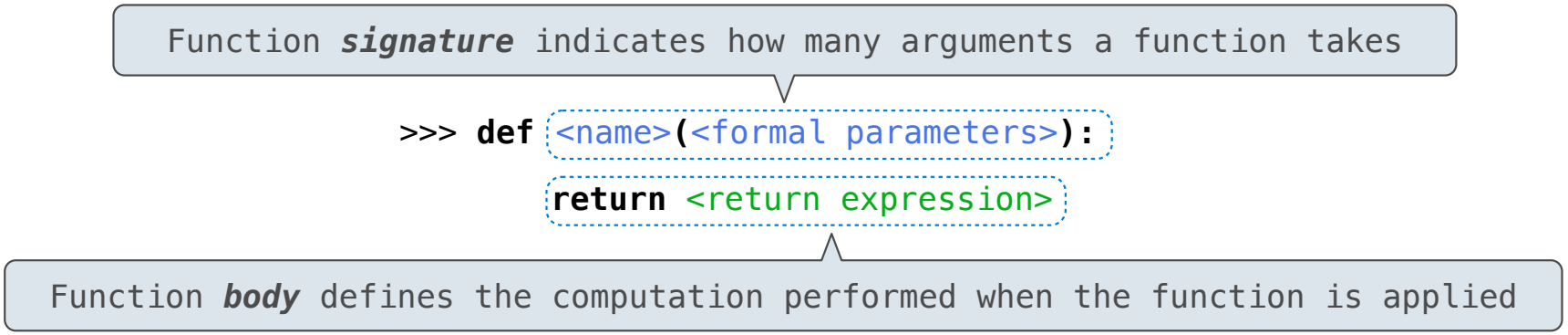

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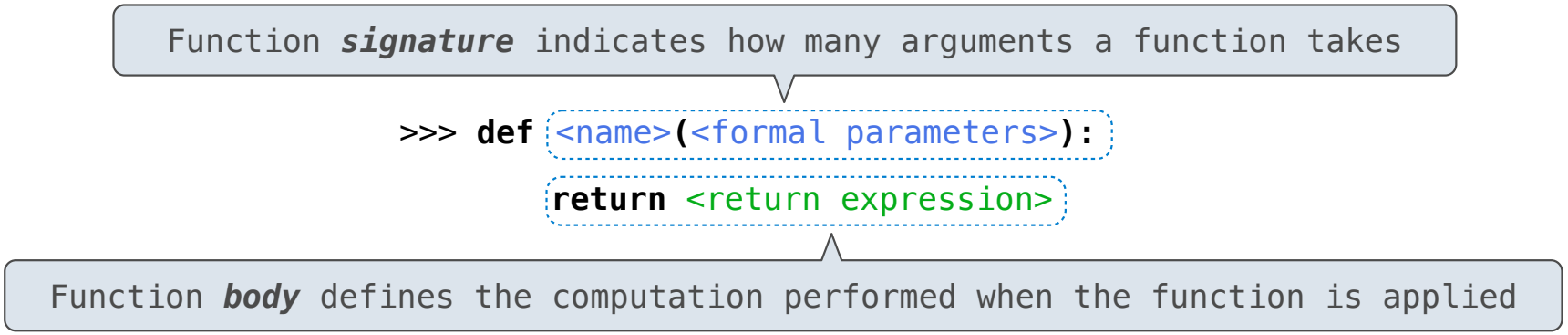

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Calling User-Defined Functions

http://pythontutor.com/composingprograms.html#code=from%20operator%20import%20mul%0Adef%20square%28x%29%3A%0A%20%20%20%20return%20mul%28x,%20x%29%0Asquare%28-2%29&cumulative=true&curInstr=0&mode=display&origin=composingprograms.js&py=3&rawInputLstJSON=%5B%5D

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Procedure for calling/applying user-defined functions (version 1):

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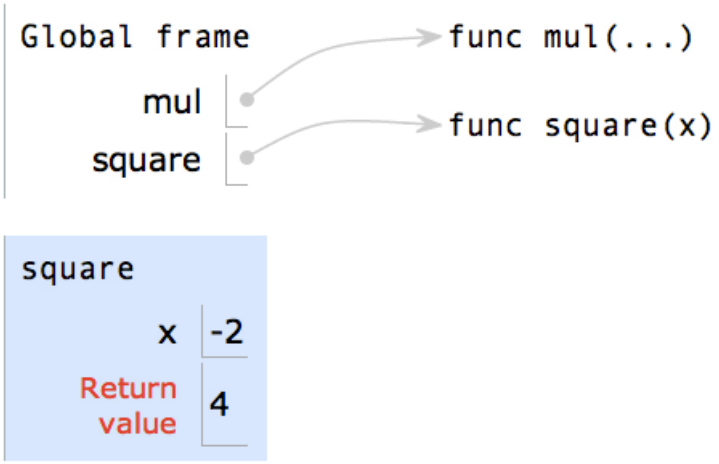

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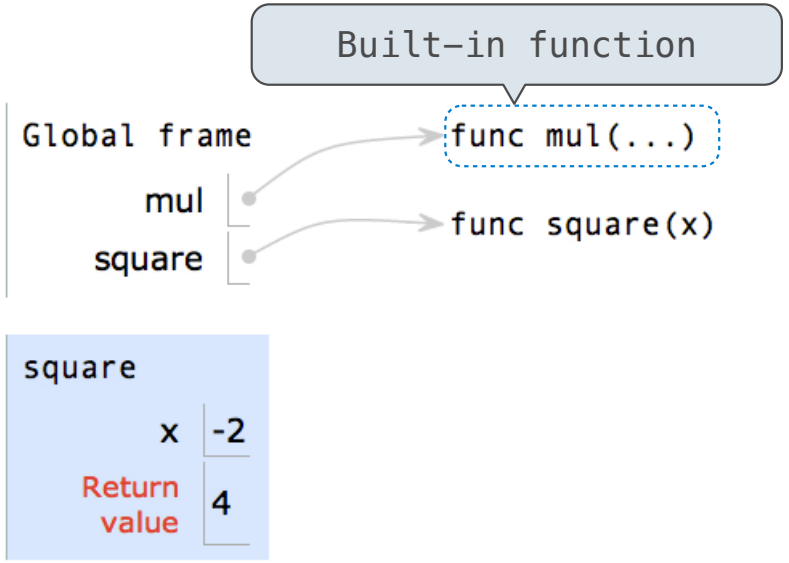

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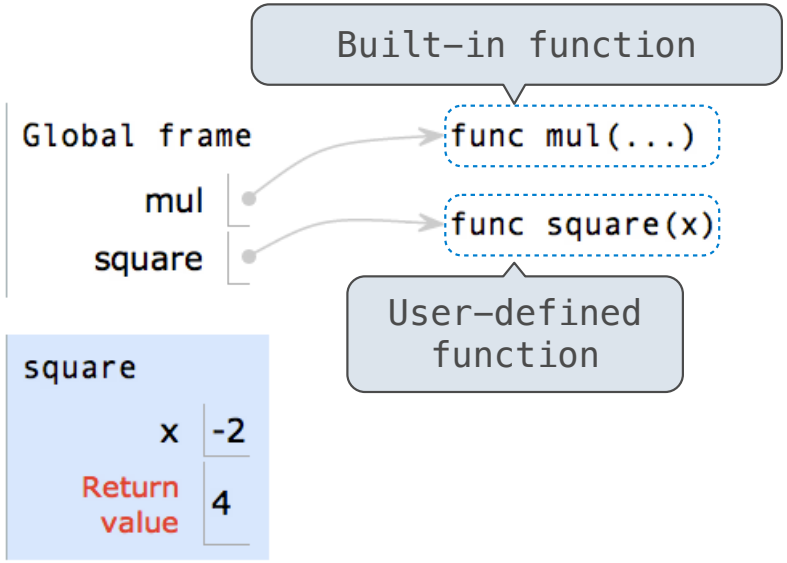

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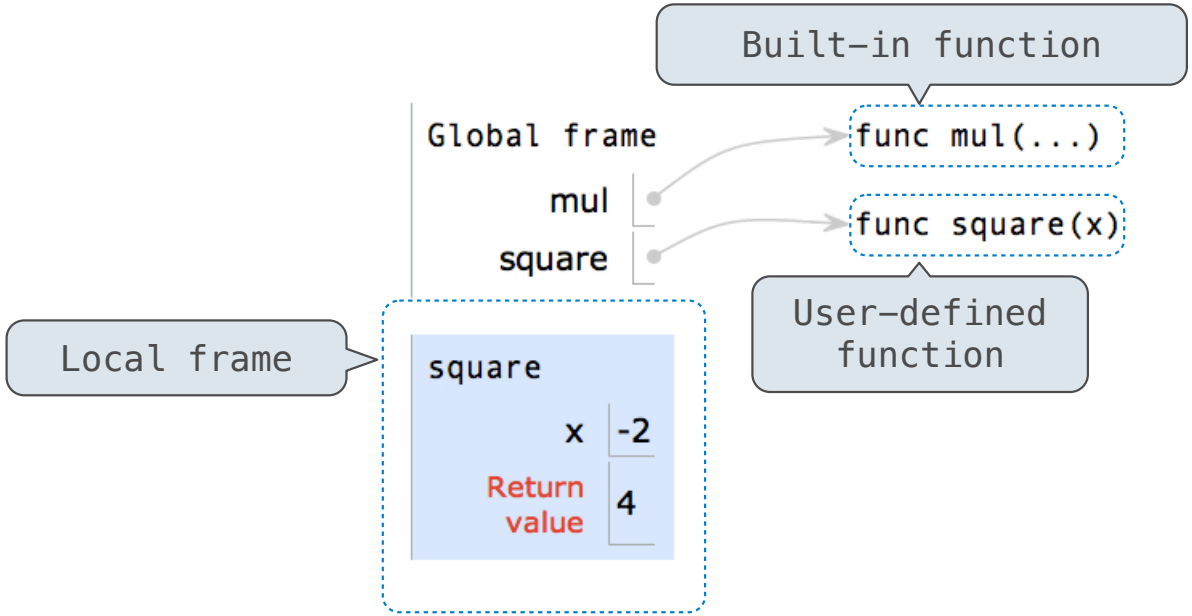

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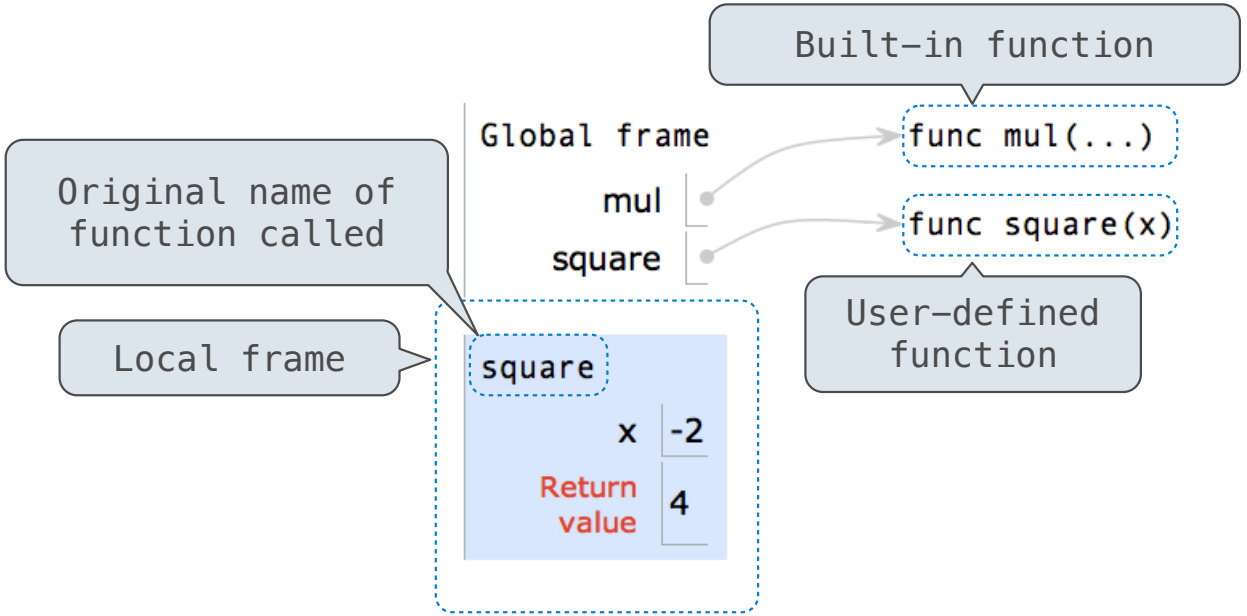

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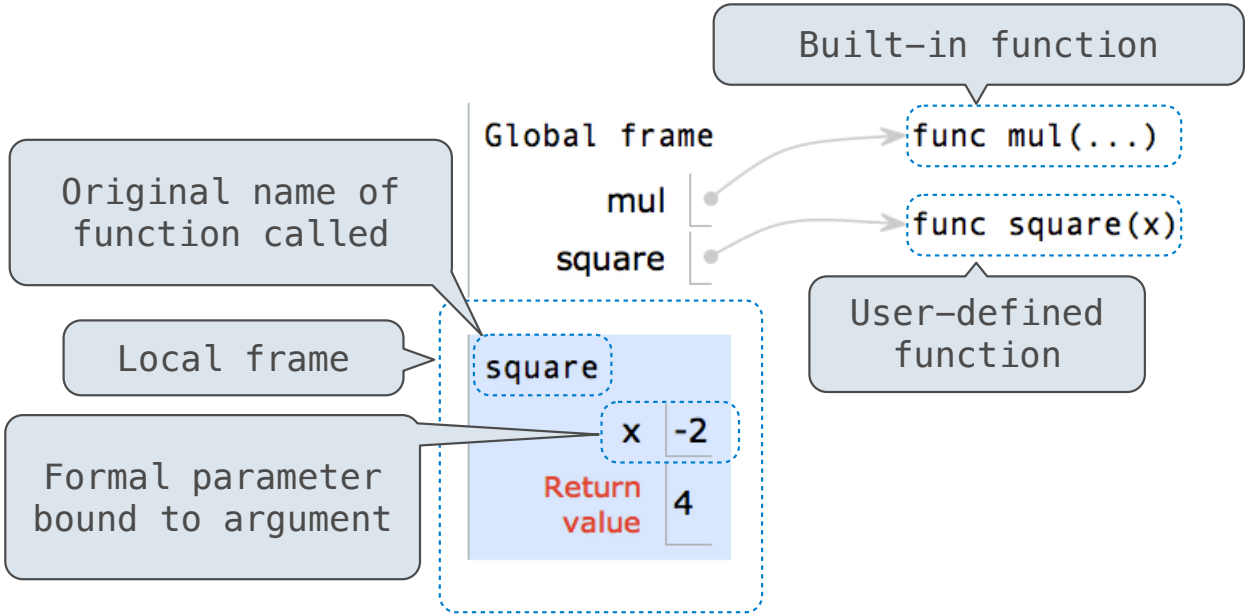

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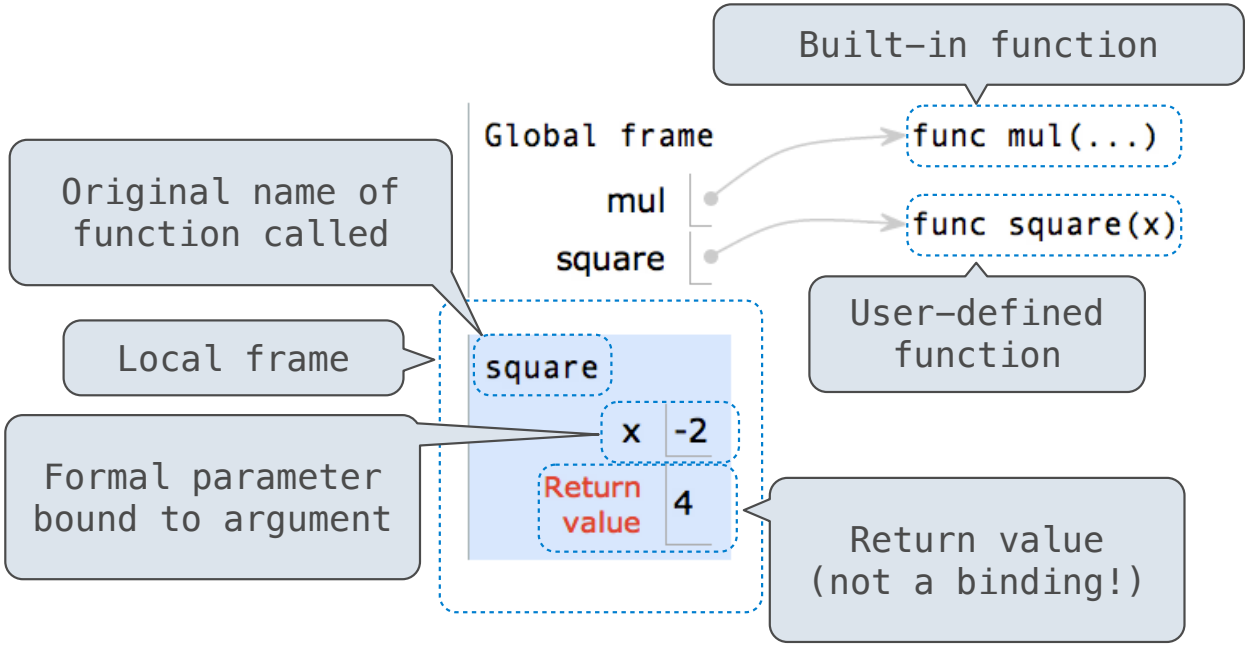

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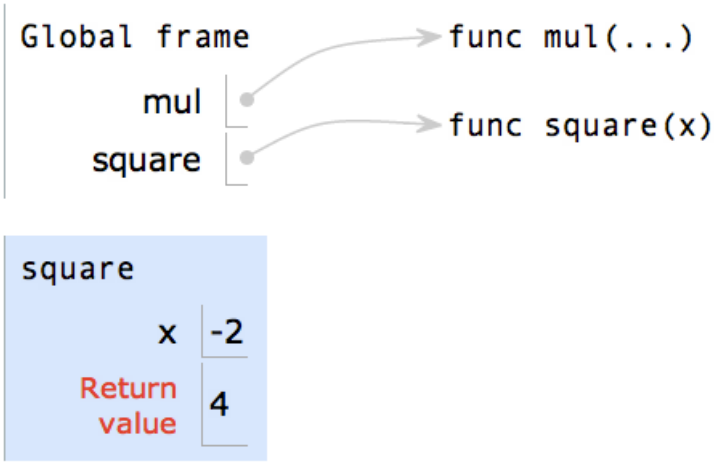

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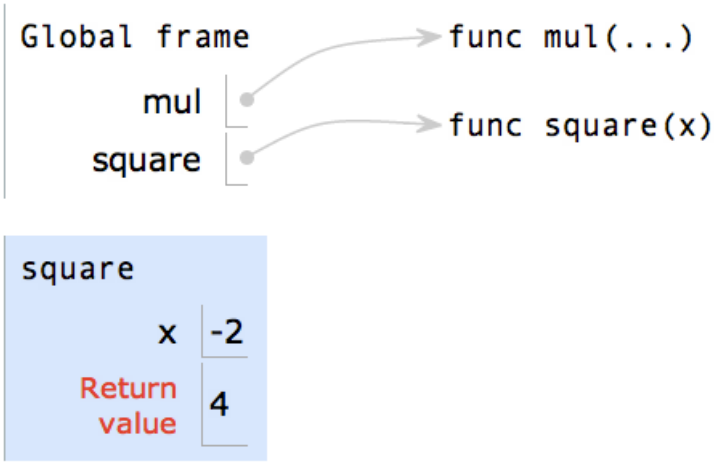

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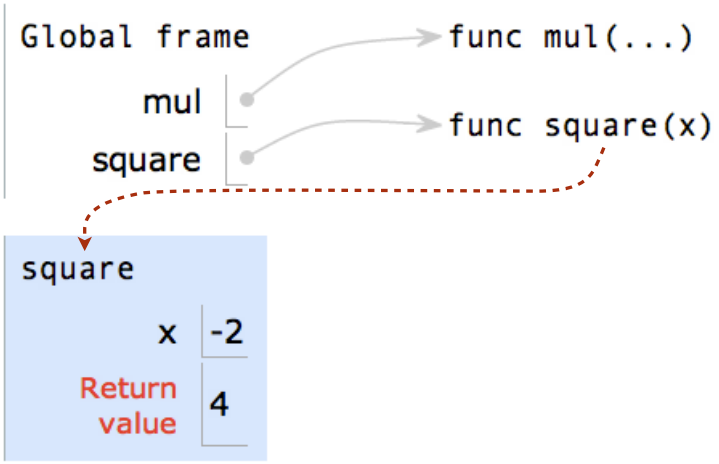

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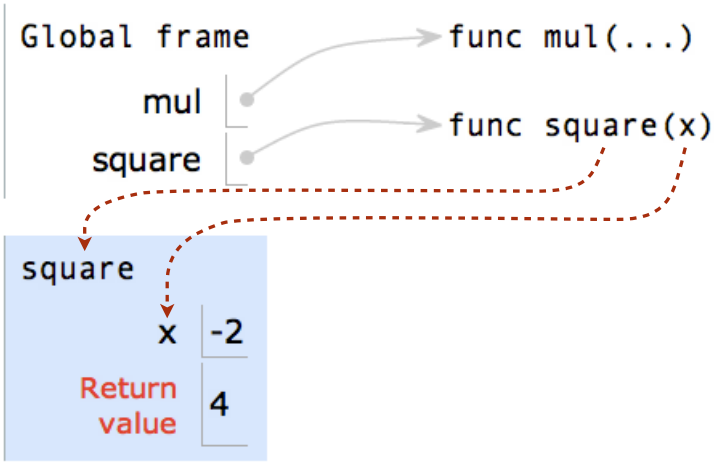

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