61A Lecture 3

Wednesday, August 31

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:

```
square( x ):
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```

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Body (*return statement*)

What happens?

Function created

Name bound

Call expression: square(2+2)

operand: 2+2
argument: 4

Calling/Applying:

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Life Cycle of a User-Defined Function

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Return expression

Def statement

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What happens?

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function: *square*

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Body (*return statement*)

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Function called with argument(s)

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Life Cycle of a User-Defined Function

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argument: 4

operator: square
function: *square*

Op's evaluated

Function called with argument(s)

Calling/Applying:

4 ▶ *square*(x):
    return mul(x, x)

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Def statement

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Calling/Applying:

4 ▶ *square*(x):
    return mul(x, x) ▶ 16

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Argument

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New frame!

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Formal parameter

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Body (*return statement*)

What happens?

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operand: 2+2
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function: *square*

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Function called with argument(s)

Calling/Applying:

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Argument

Signature

Return value

New frame!

Params bound

Life Cycle of a User-Defined Function

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Function called with argument(s)

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Return value

New frame!

Params bound

Body executed

Life Cycle of a User-Defined Function

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Formal parameter

Name

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Body (*return statement*)

What happens?

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Argument

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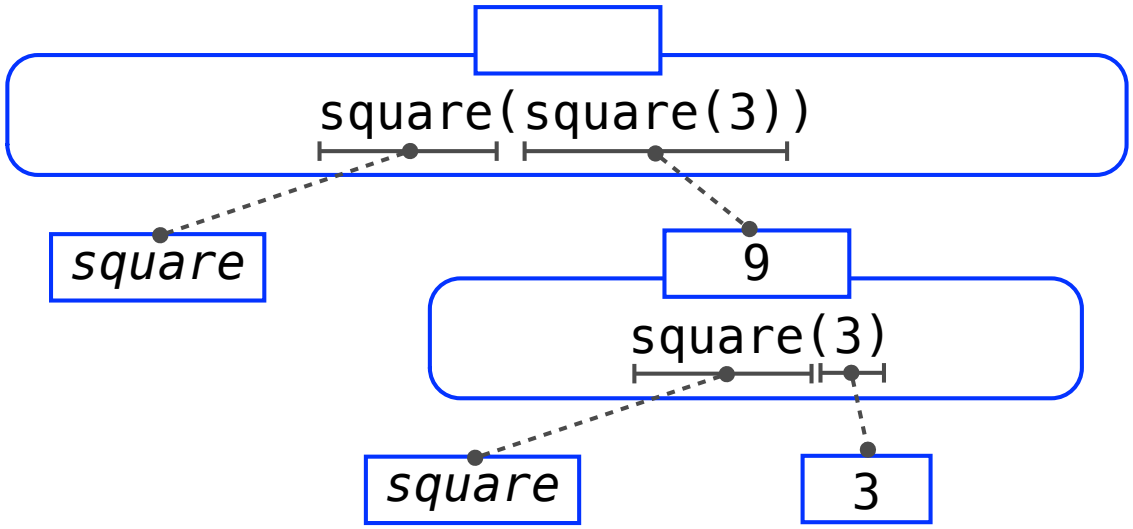
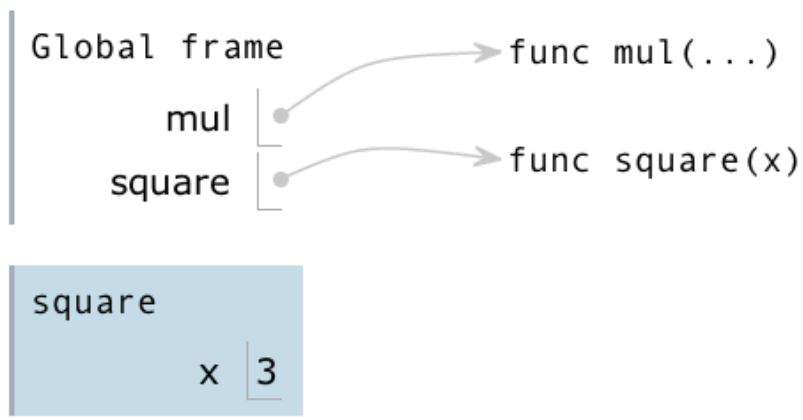
Params bound

Body executed

Multiple Environments in One Diagram!

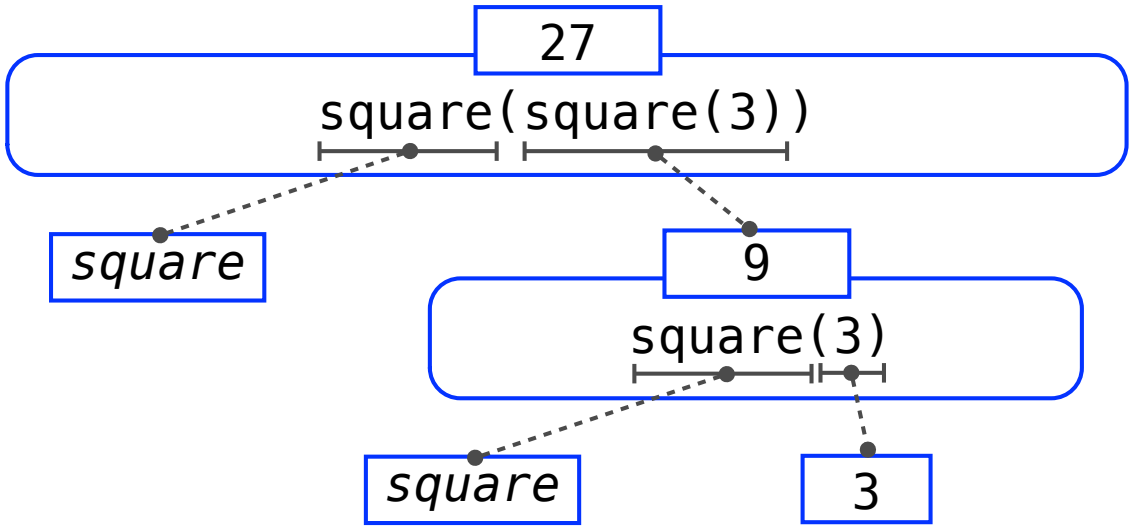



```
1 from operator import mul
2 def square(x):
3     return mul(x, x)
4 square(square(3))
```

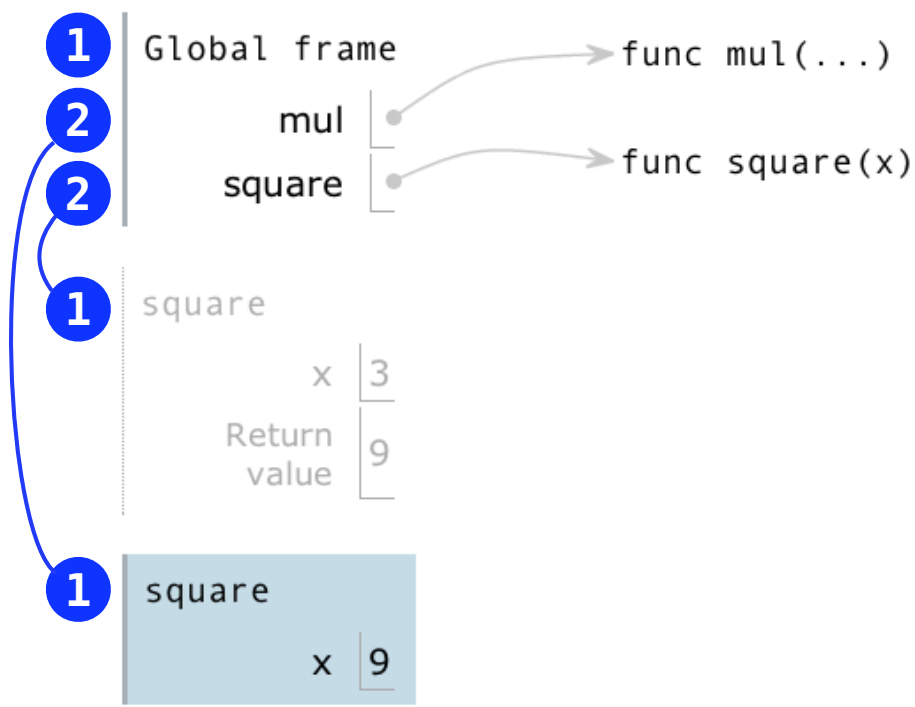


Example: http://goo.gl/668fU

Multiple Environments in One Diagram!




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



An **environment** is a **sequence** of frames.

- The global frame alone
- A local, then the global frame

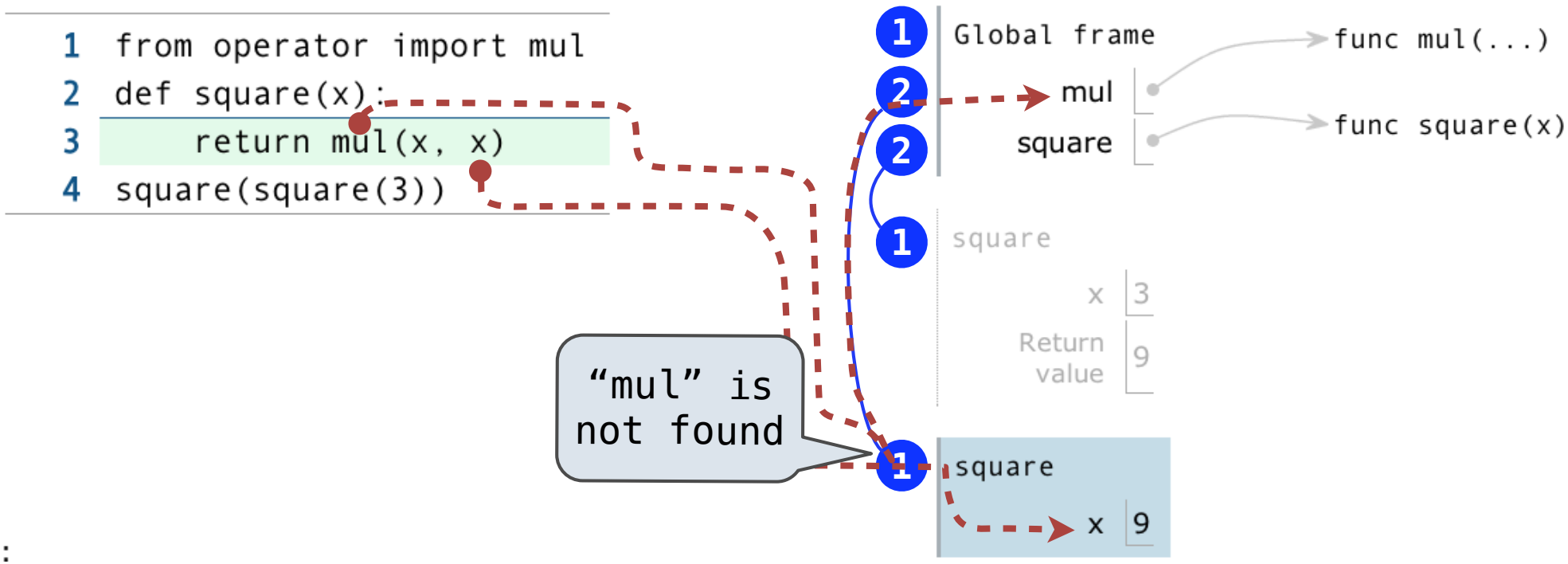
Example: http://goo.gl/668fU

Names Have No Meaning Without Environments

Every expression is evaluated in the context of an environment.

A name evaluates to the value bound to that name in the earliest frame of the current environment in which that name is found.

mul(x, x)



Example: http://goo.gl/668fU

Formal Parameters

Example: http://goo.gl/OapJa

Formal Parameters

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def square(x):
    return mul(x, x)
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Formal Parameters

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def square(x):
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vs

Example: http://goo.gl/OapJa

Formal Parameters

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

vs

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

Example: http://goo.gl/OapJa

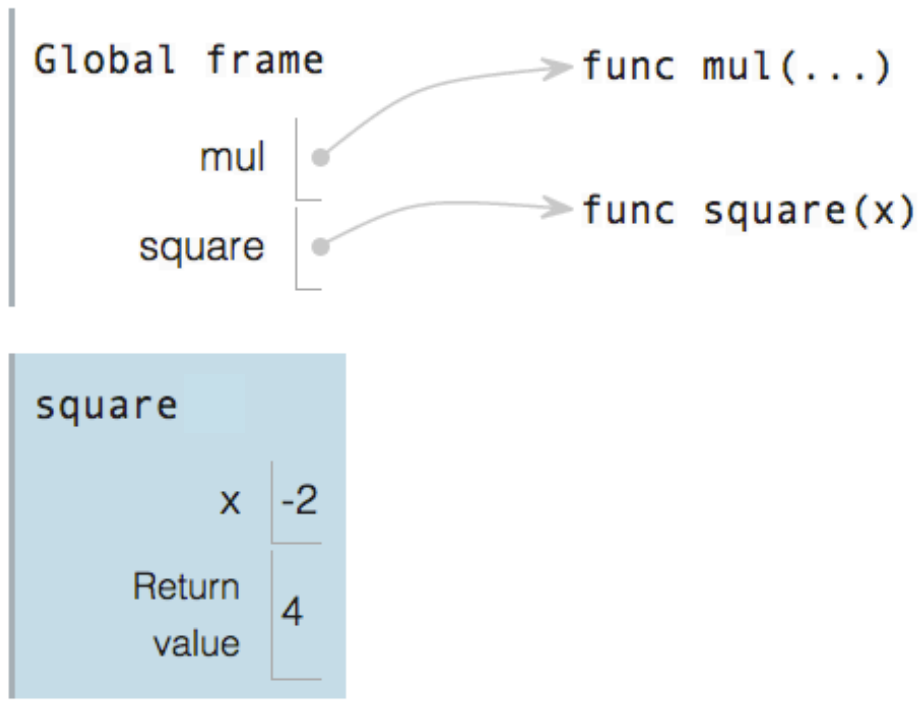
Formal Parameters

```
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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vs

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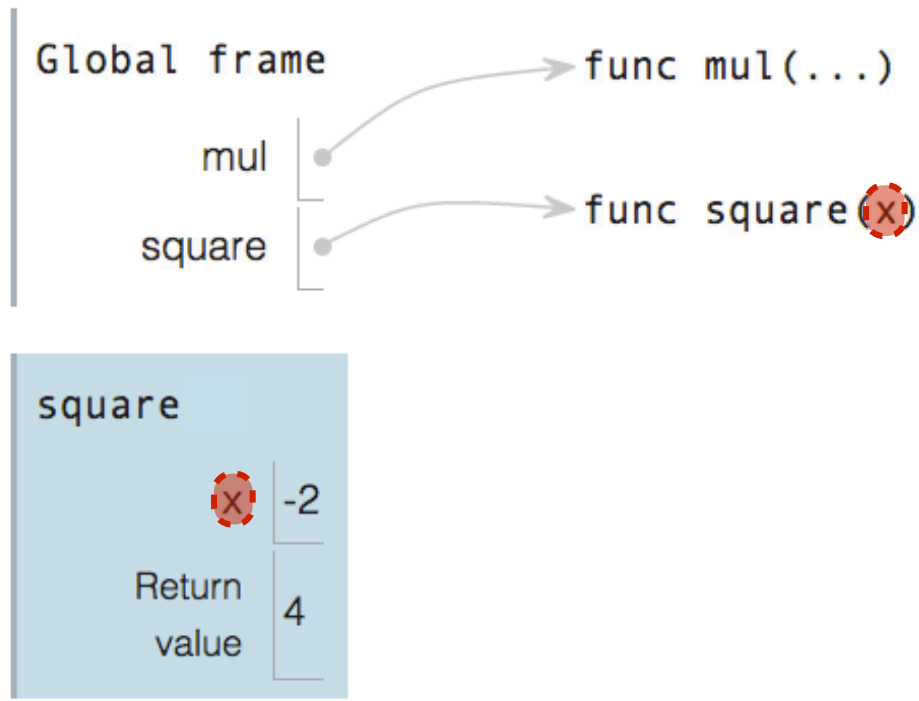

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Formal Parameters

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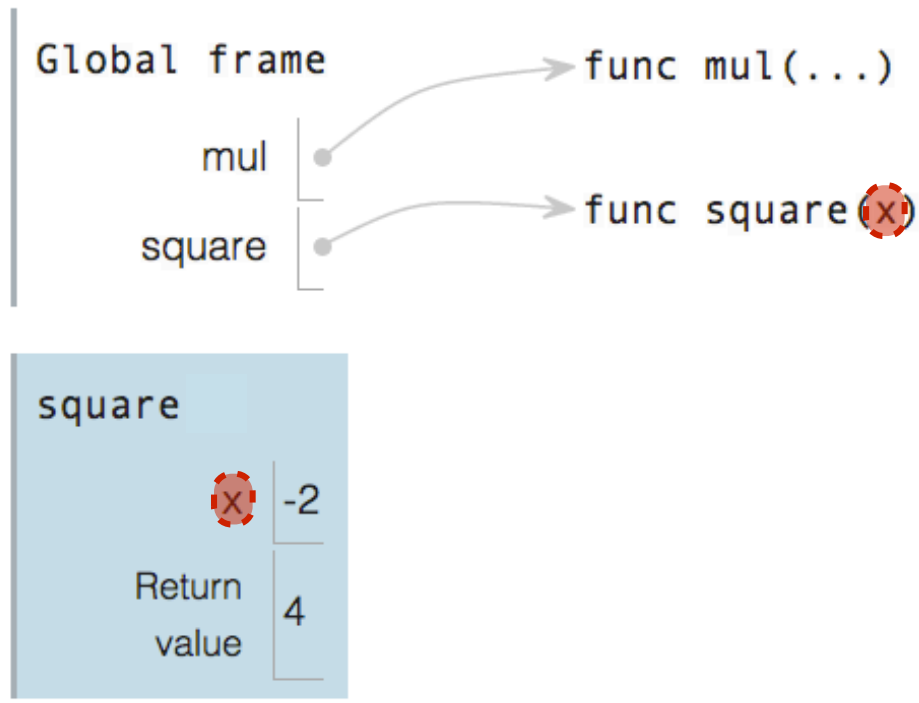

Formal parameters have local scope

Formal Parameters

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```

vs

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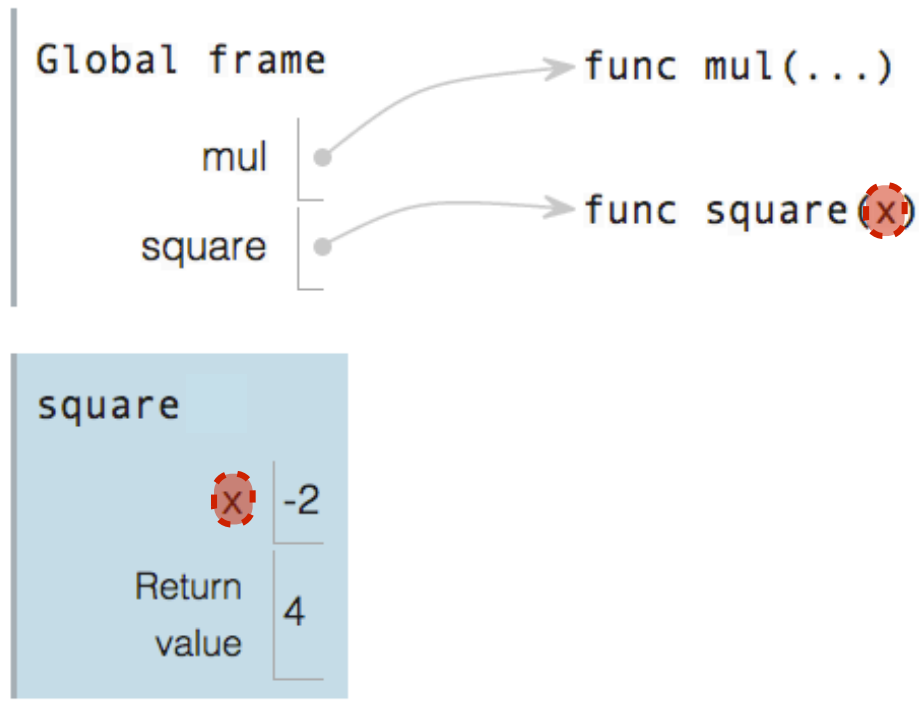

Formal parameters have local scope

(Demo)

Example: http://goo.gl/OapJa

Python Feature Demonstration

<Demo>

Operators

Multiple Return Values

Docstrings

Doctests

Default Arguments

Statements

</Demo>

Statements

A statement

is executed by the interpret

to perform an action

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Compound statements:

```
<header>:
    <statement>
    <statement>
    ...
<separating header>:
    <statement>
    <statement>
    ...
...
```

Statements

A statement

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Compound statements:

Statement

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    ...
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    <statement>
    <statement>
    ...
...
```

Statements

A statement

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Compound statements:

Statement

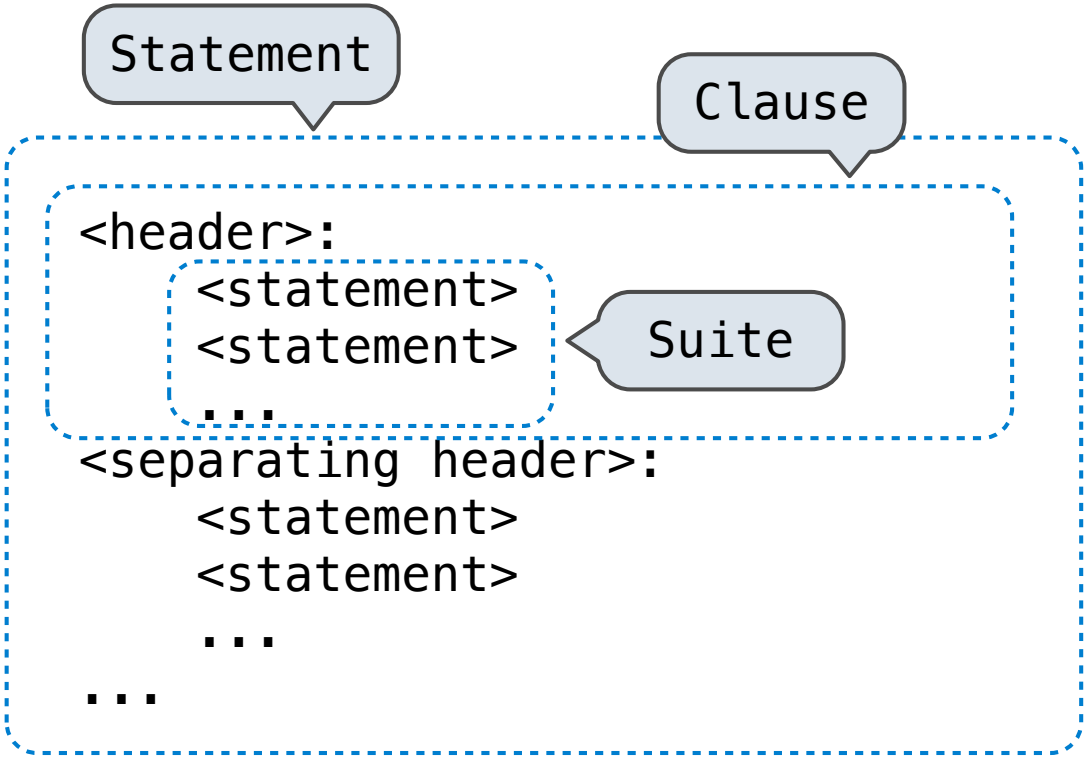
Clause

```
<header>:
    <statement>
    <statement>
    ...
<separating header>:
    <statement>
    <statement>
    ...
...
```

Statements

A statement
is executed by the interpret
to perform an action

Compound statements:



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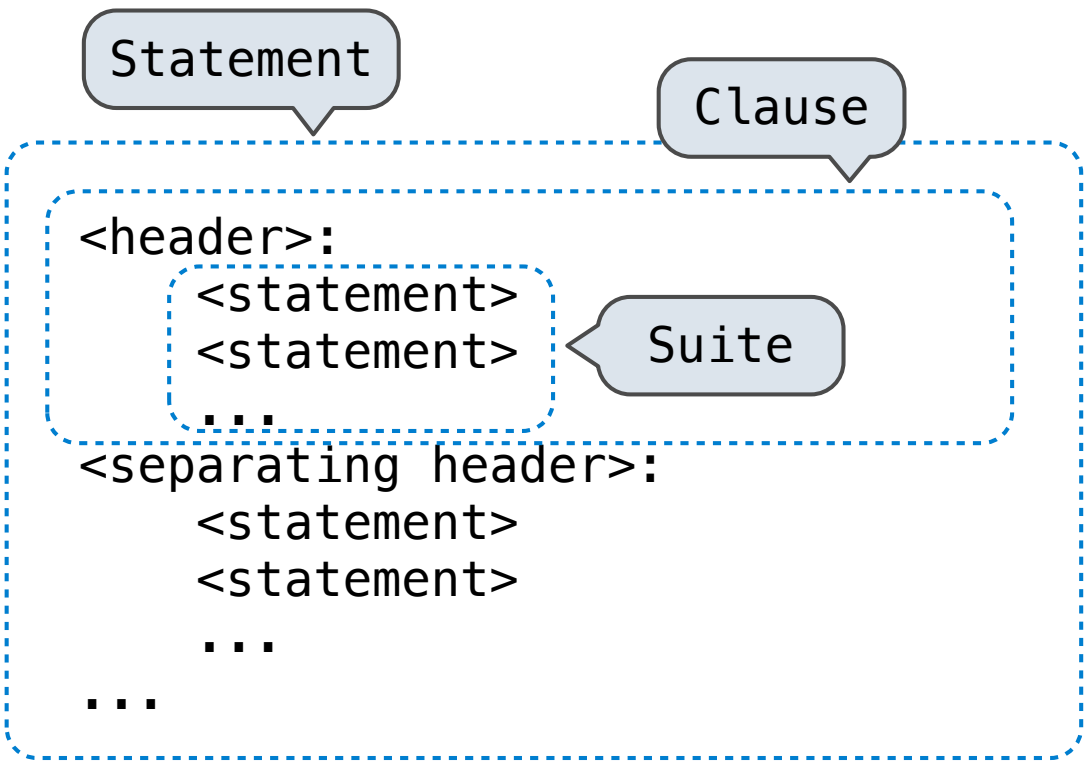

The first header determines a statement's type

Statements

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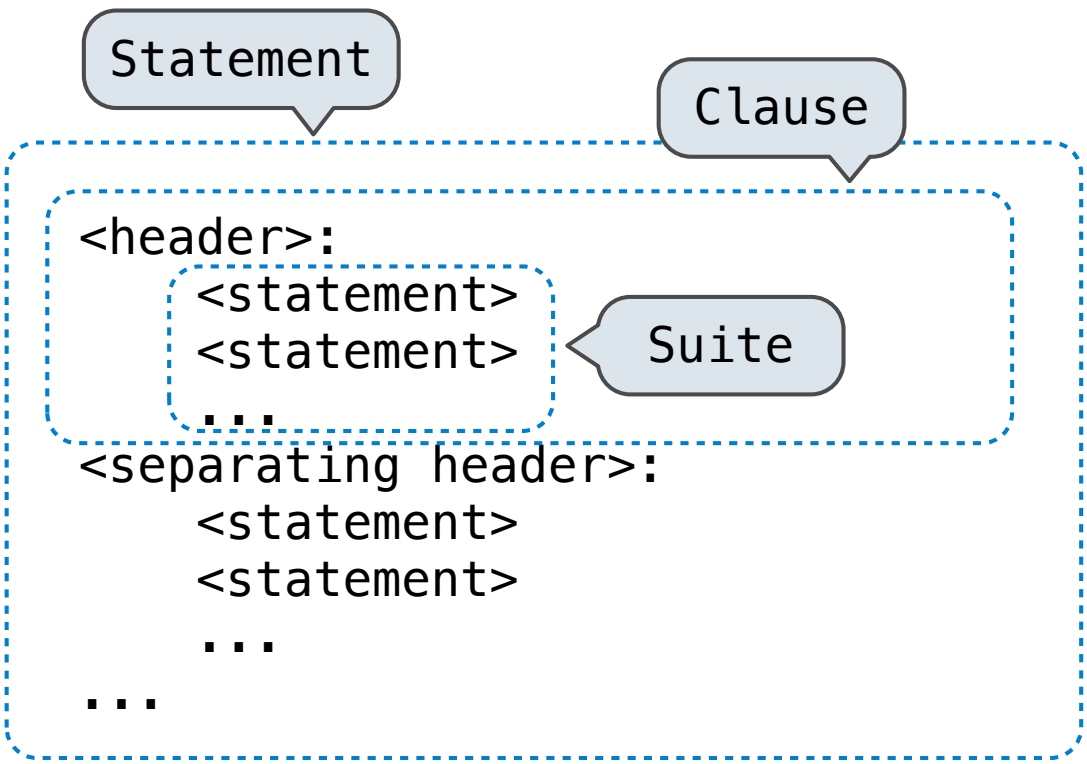

The first header determines a statement's type

The header of a clause "controls" the suite that follows

Statements

A statement

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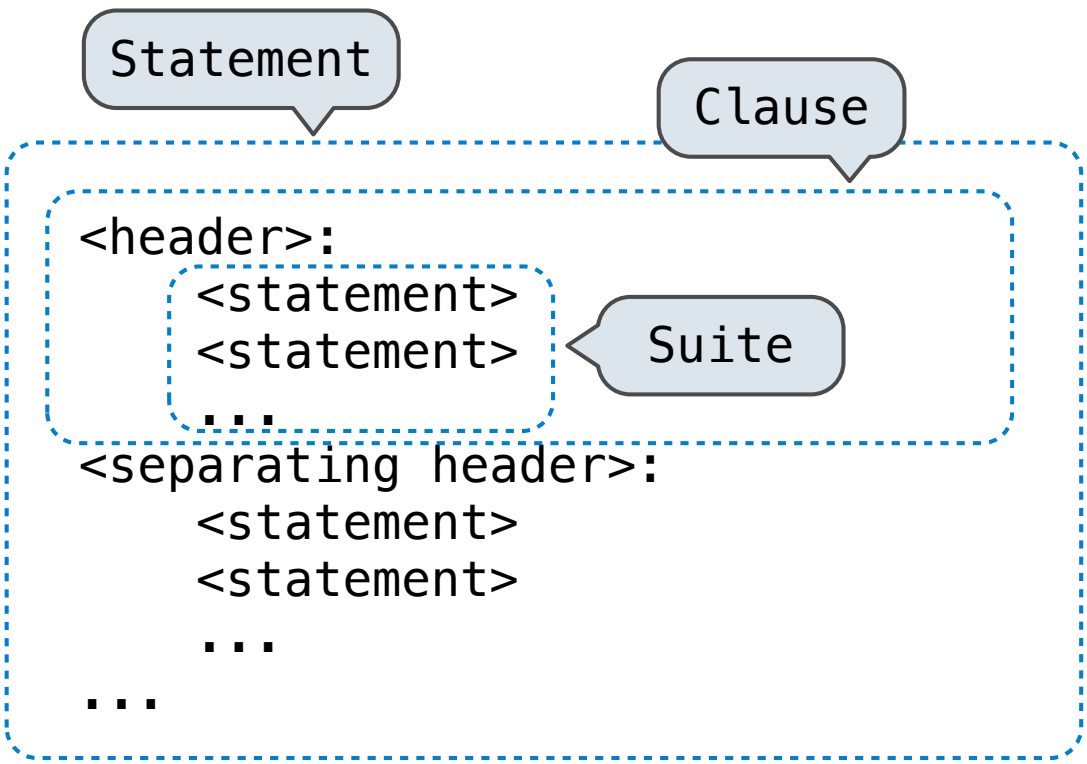
Compound statements:



The first header determines a statement's type

The header of a clause "controls" the suite that follows

def statements are compound statements

Compound Statements

Compound statements:

```
<header>:
    <statement>
    <statement>
    ...
<separating header>:
    <statement>
    <statement>
    ...
...
```

Suite

Compound Statements

Compound statements:

```
<header>:
    <statement>
    <statement>
    ...
<separating header>:
    <statement>
    <statement>
    ...
...
```

Suite

A suite is a sequence of statements

Compound Statements

Compound statements:

```
<header>:
    <statement>
    <statement>
    ...
<separating header>:
    <statement>
    <statement>
    ...
...
```

Suite

A suite is a sequence of statements

To “execute” a suite means to execute its sequence of statements, in order

Compound Statements

Compound statements:

```
<header>:
    <statement>
    <statement>
    ...
<separating header>:
    <statement>
    <statement>
    ...
...
```

Suite

A suite is a sequence of statements

To “execute” a suite means to execute its sequence of statements, in order

Execution Rule for a sequence of statements:

- Execute the first
- Unless directed otherwise, execute the rest

Local Assignment

```
def percent_difference(x, y):
        difference = abs(x-y)
        return 100 * difference / x
percent_difference(40, 50)
```

Local Assignment

```
def percent_difference(x, y):
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```

Conditional Statements

```
def absolute_value(x):
        """Return the absolute value of x."""
        if x > 0:
            return x
        elif x == 0:
            return 0
        else:
            return -x
```

Conditional Statements

```
def absolute_value(x):
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1 statement,
3 clauses,
3 headers,
3 suites

Conditional Statements

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Execution rule for conditional statements:

Conditional Statements

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1 statement,
3 clauses,
3 headers,
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Execution rule for conditional statements:

Each clause is considered in order.

1. Evaluate the header's expression.

2. If it is a true value, execute the suite & skip the rest.

Boolean Contexts

George Boole

```
def absolute_value(x):
    """Return the absolute value of x."""
    if x > 0:
        return x
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Two boolean contexts

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Two boolean contexts

False values in Python: False, 0, '', None

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False values in Python: False, 0, '', None *(more to come)*

True values in Python: Anything else (True)

Boolean Contexts

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Two boolean contexts

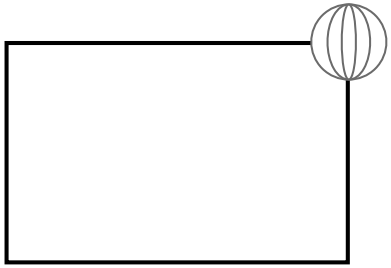
False values in Python: False, 0, '', None *(more to come)*

True values in Python: Anything else (True)

Read Section 1.5.4!

Iteration

```
i, total = 0, 0
while i < 3:
    i = i + 1
    total = total + i
```



```
0
1
2
3
6
```

Execution rule for while statements:

1. Evaluate the header's expression.

2. If it is a true value,
   execute the (*whole*) suite,
   then return to step 1.

Iteration

```
i, total = 0, 0
while i < 3:
    i = i + 1
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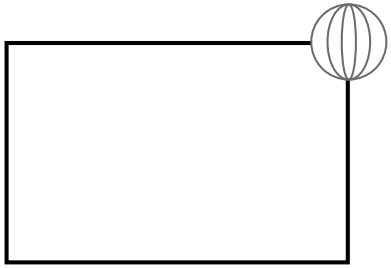

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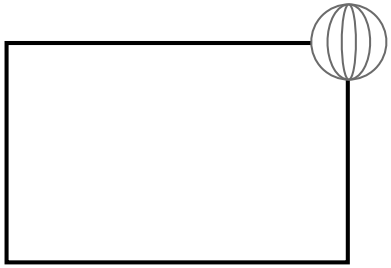

```
0
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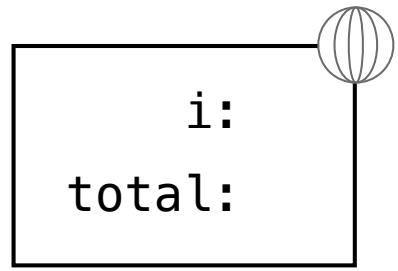

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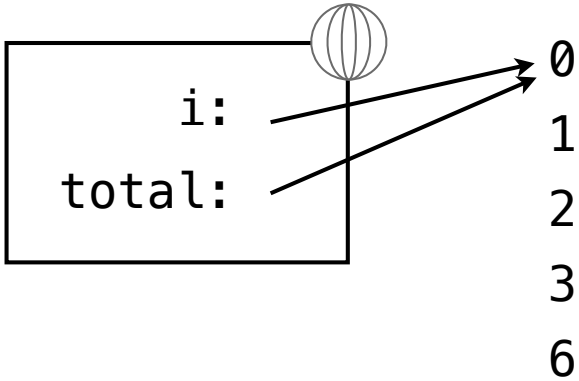

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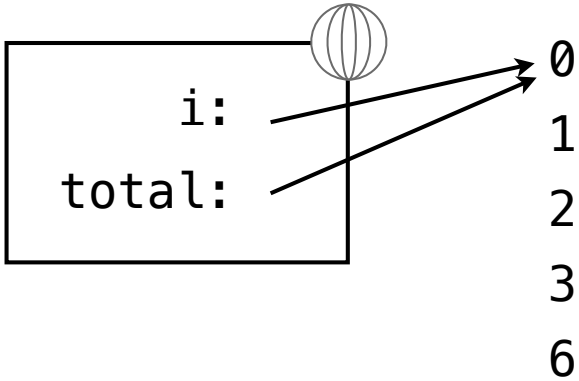

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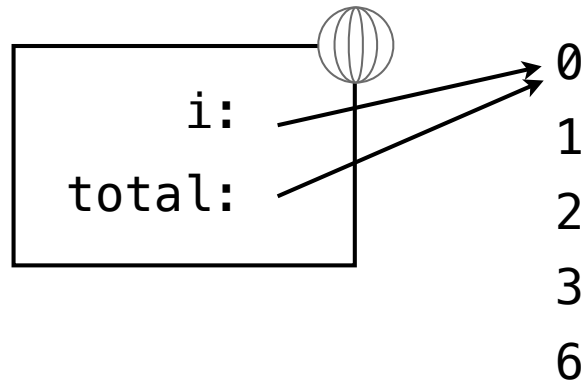

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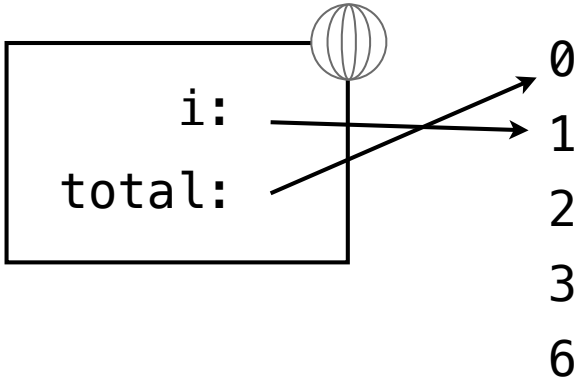

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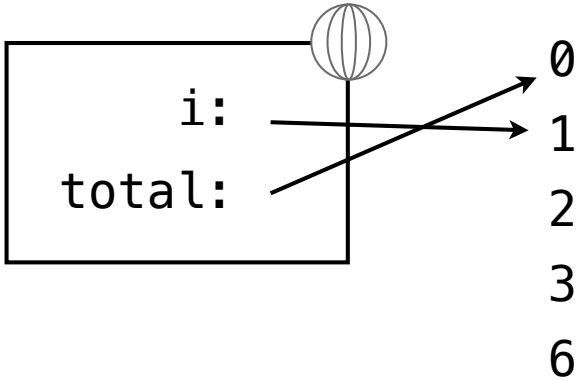

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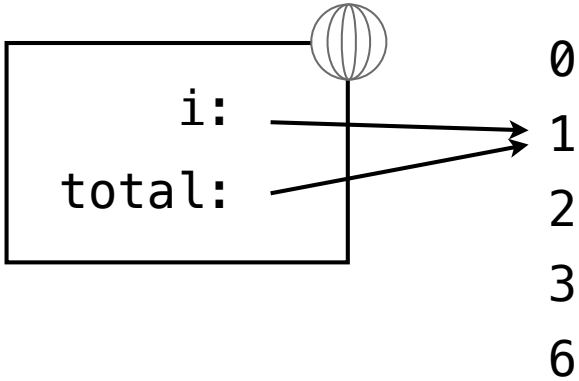

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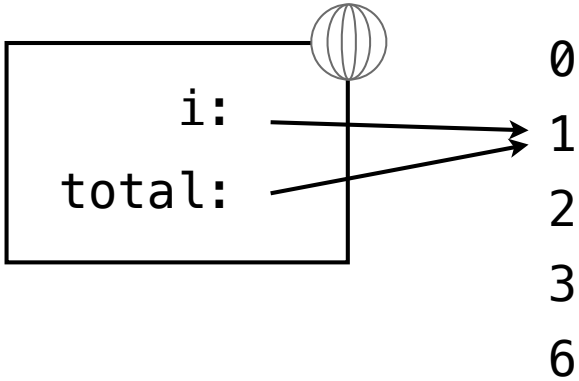

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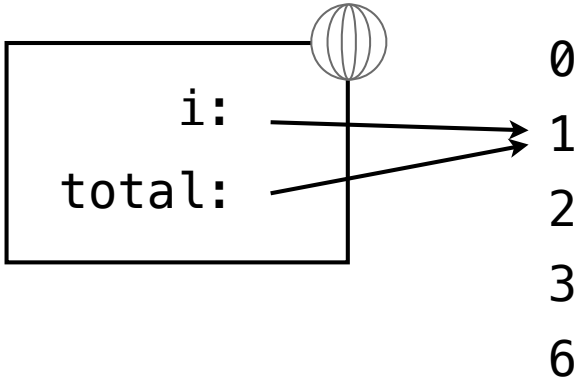

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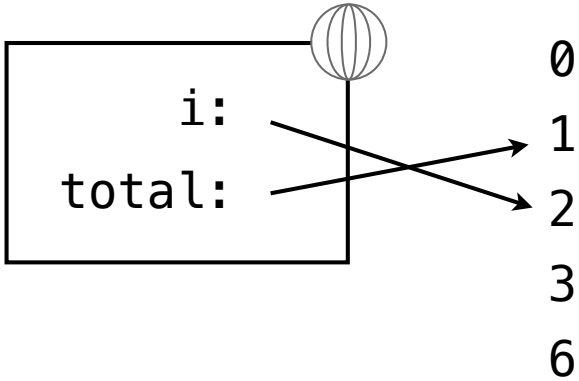

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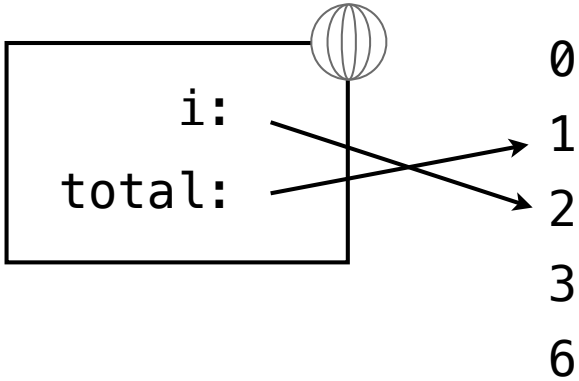

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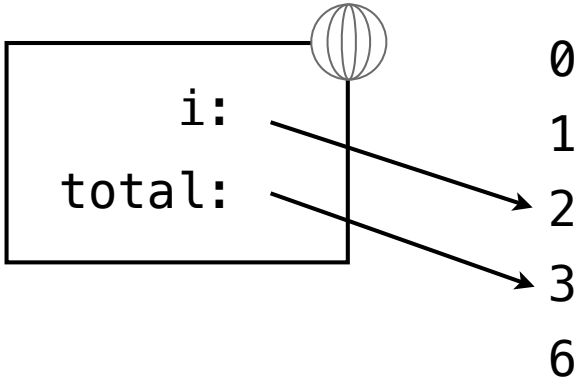

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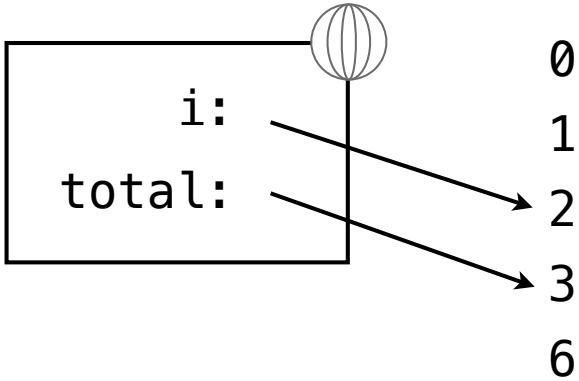

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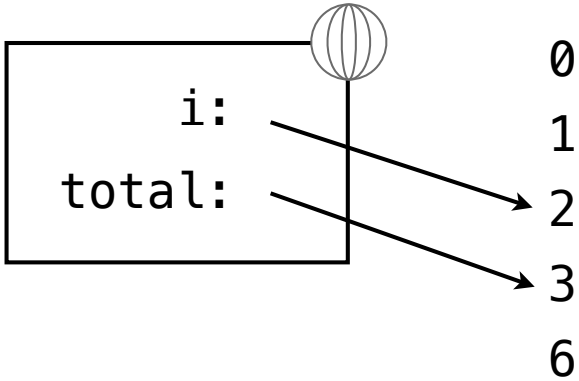

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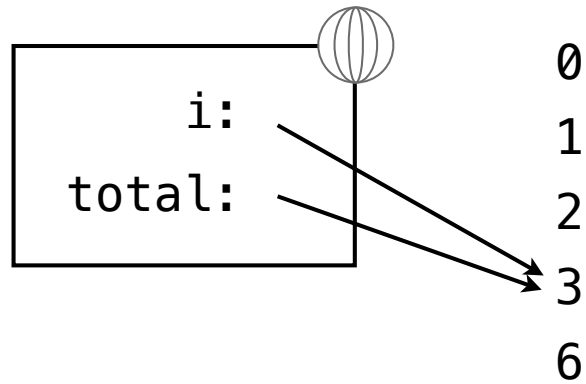

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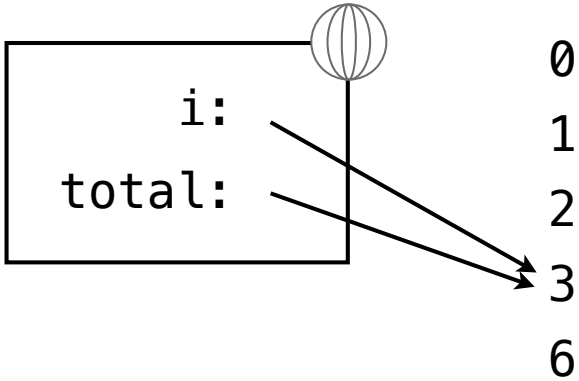

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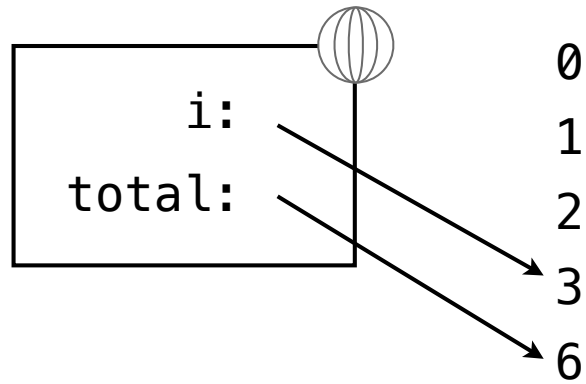

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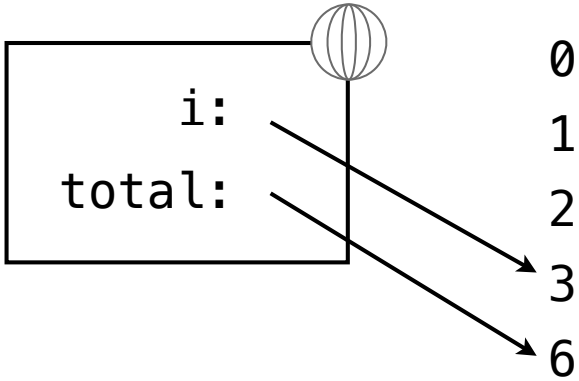

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0, 1, 1, 2, 3, 5, 8, 13, ...

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def fib(n):
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    pred, curr = 0, 1   # First two Fibonacci numbers
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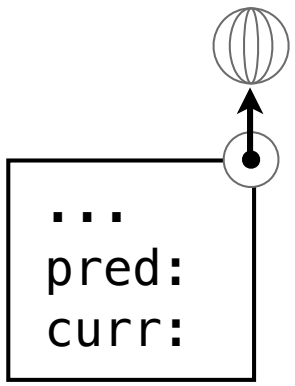

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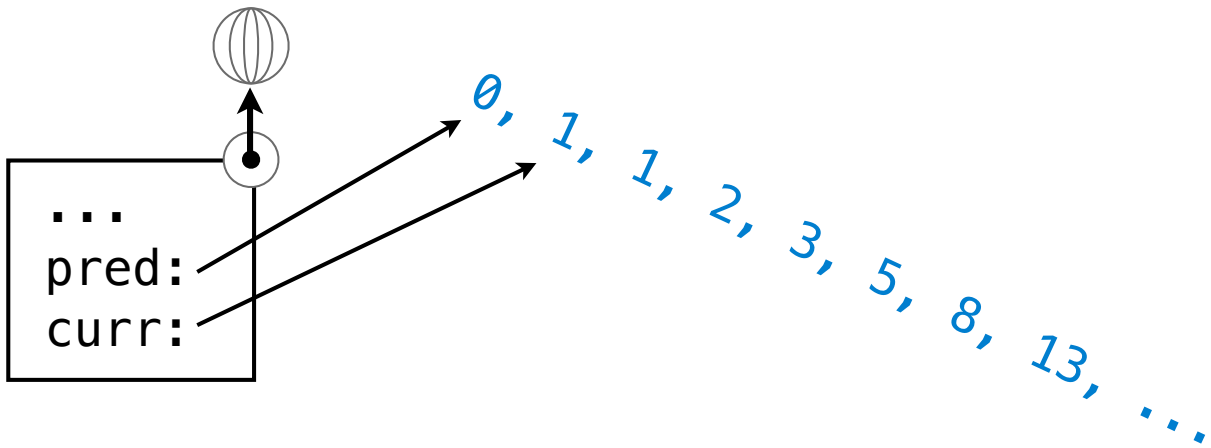


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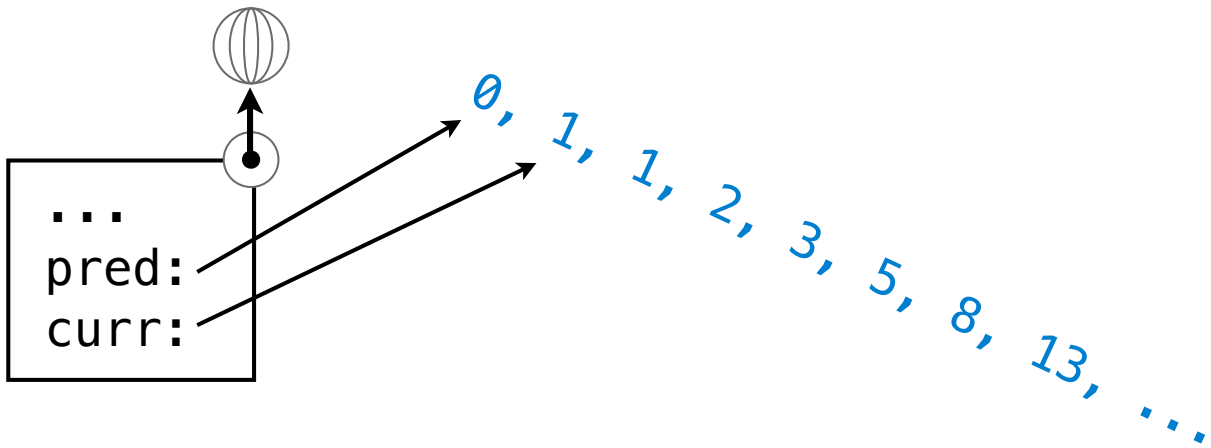


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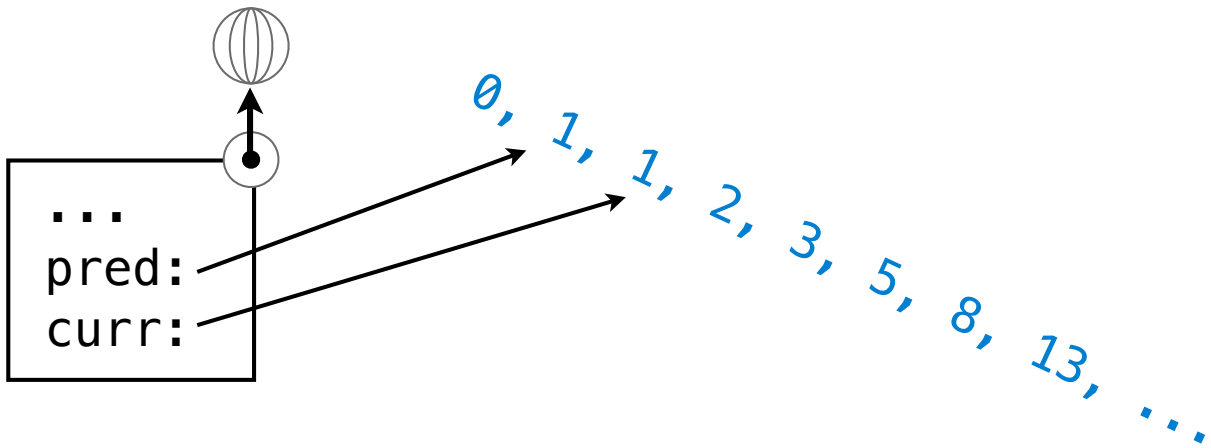


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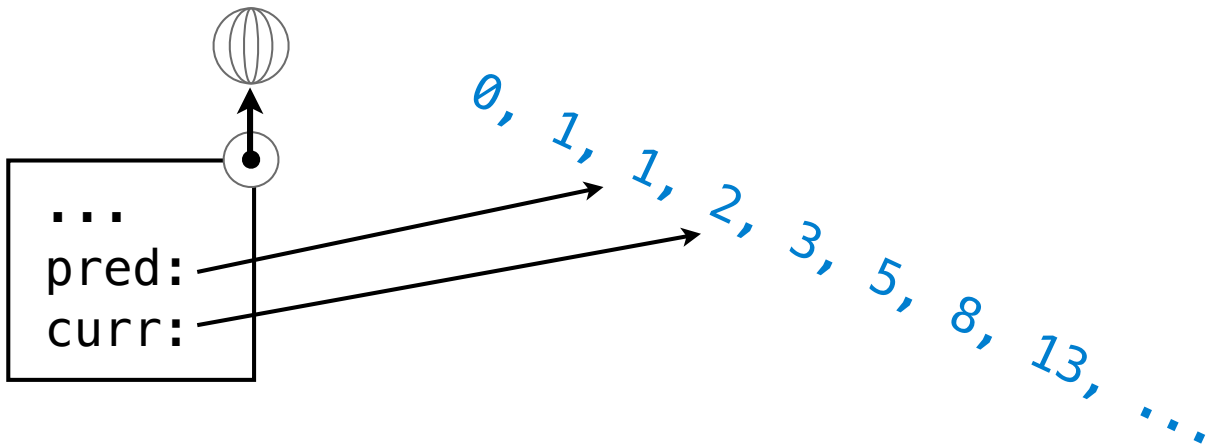


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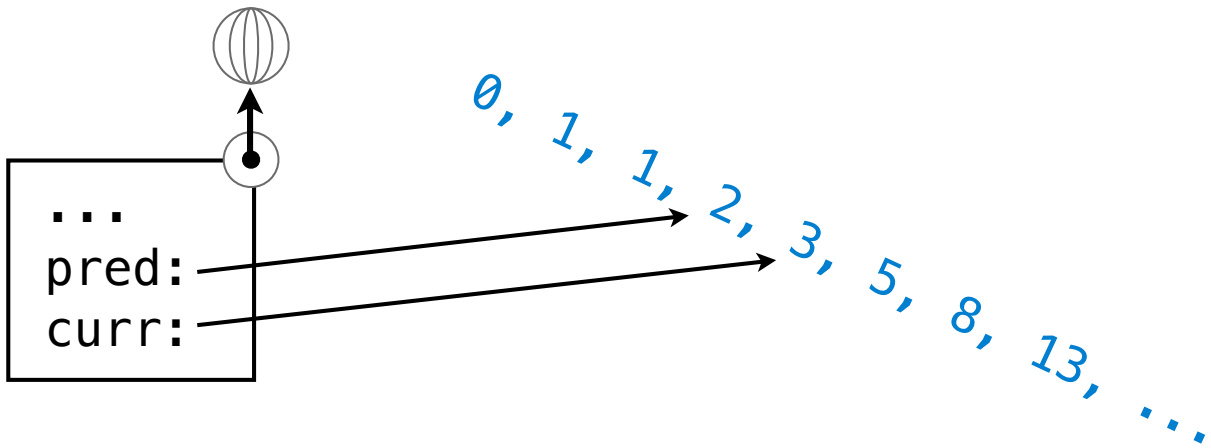


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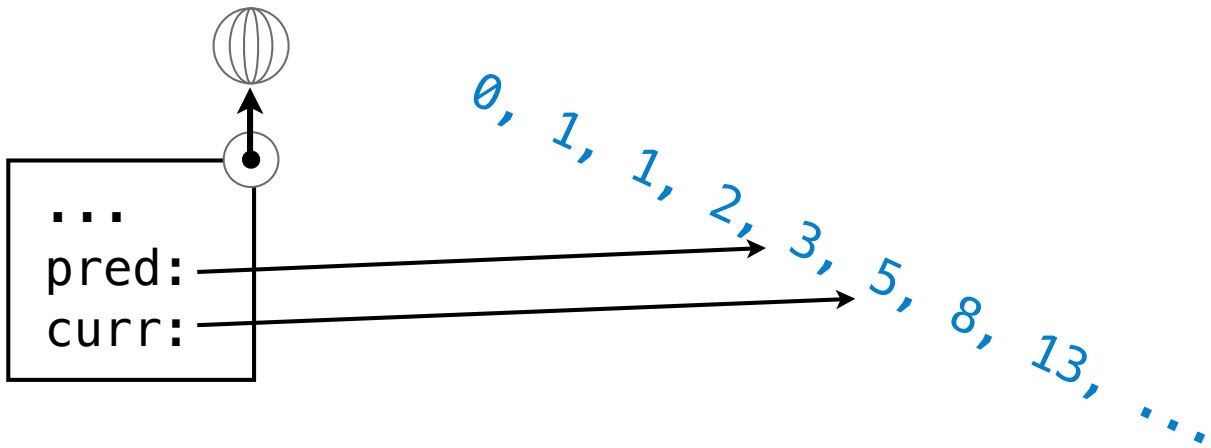


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Project 1: Hog

(Demo)