Discussion 1

Walkthrough

Announcements

- Start HOG early!
- Find partners on Piazza (https://piazza.com/class/irwl7o7shzu70z?cid=5)
- My office hours: T/W 4-5 @ 109 Morgan Hall
    - email me at katya.stukalova@berkeley.edu

Environment Diagram Rules

1. Assignment

ex: `a = 3`

1. evaluate the RHS
2. assign the value from step 1 to the name on the LHS

G:

a : 3

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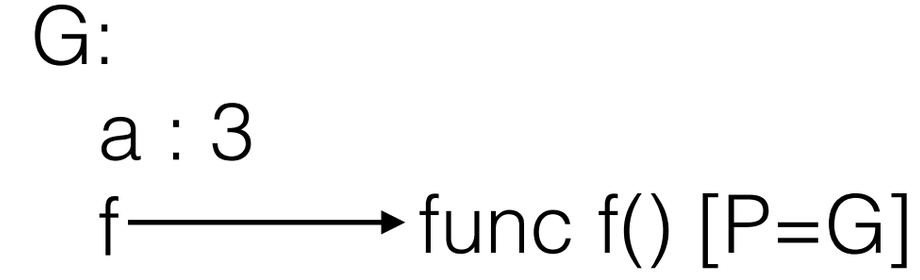

2. Defining a function

ex:
```
def f():
    return 1
```

1. write function signature
2. write the function name
3. point the name to the signature

Environment Diagram Rules

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ex: `a = 3`

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2. assign the value from step 1 to the name on the LHS

2. Defining a function

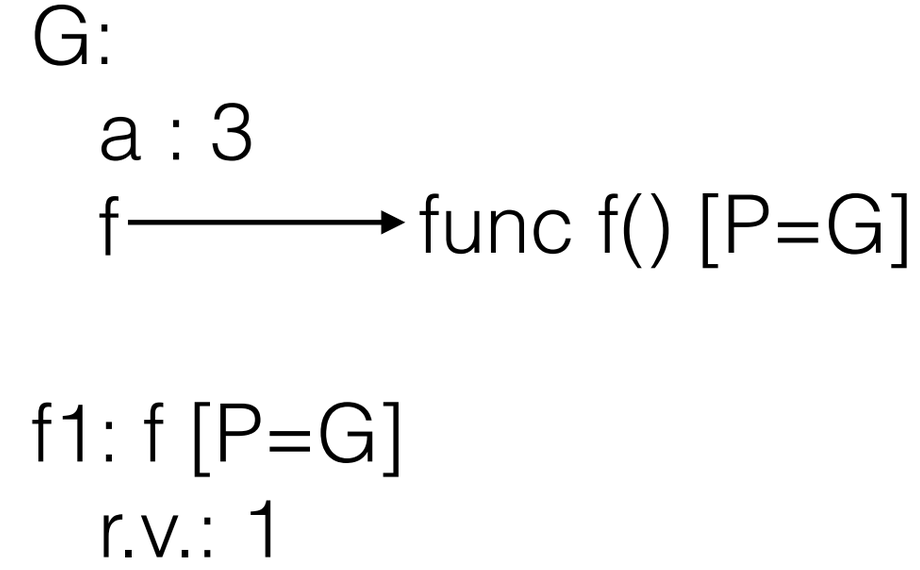
ex:
```
def f():
    return 1
```

1. write function signature
2. write the function name
3. point the name to the signature

3. Function call

ex: `a = f()`

1. evaluate the operator
2. evaluate the operands
3. open a new frame
   - label the frame with: f#, the intrinsic function name, [P=G]
4. copy the parameters into the new frame
   - remember to use the names from the function signature
5. execute the body of the function



2.1 #1

Draw the environment diagram that results from running the following code.

```
a = 1
def b(b):
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Reasoning

Solution

Draw the environment diagram that results from running the following code.

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Reasoning

- the first line is an assignment statement (recall the procedure for assignment statements)

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Solution

G

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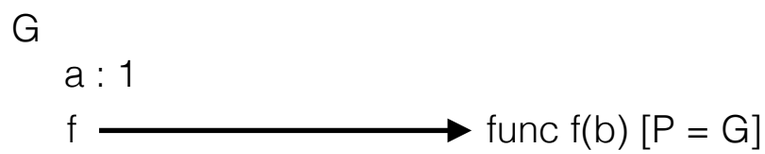

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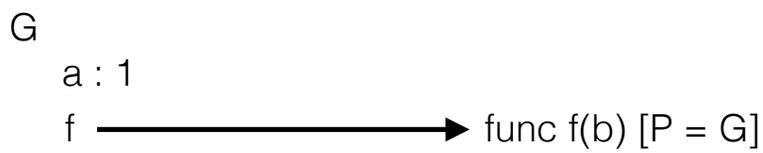

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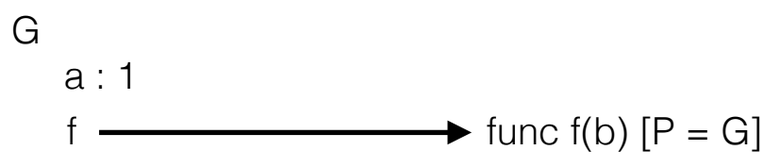

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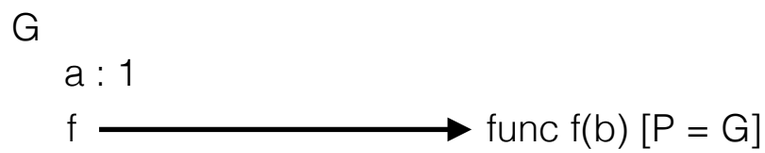

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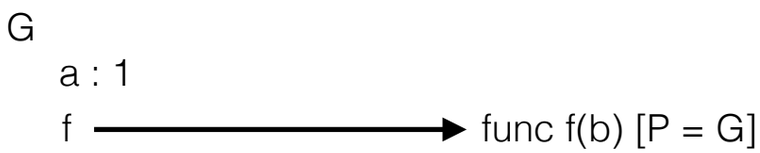

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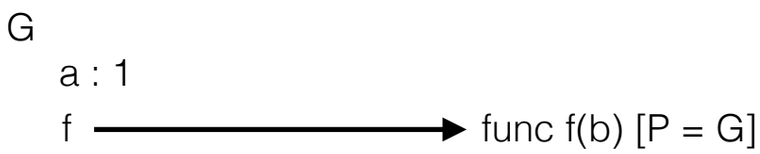

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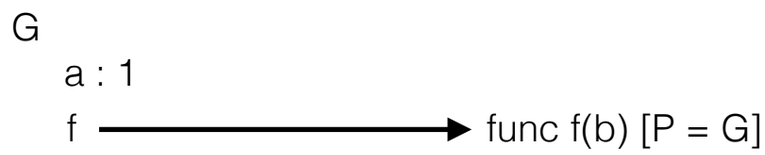

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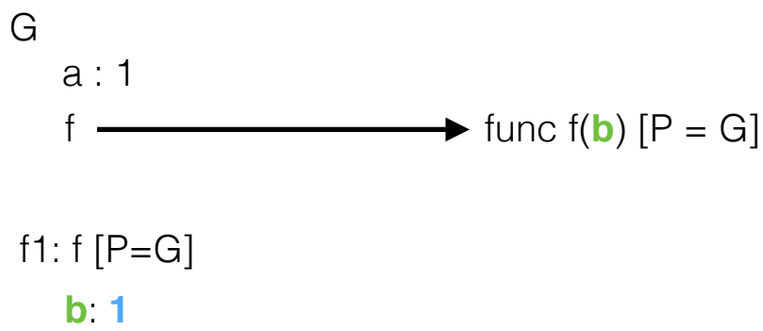

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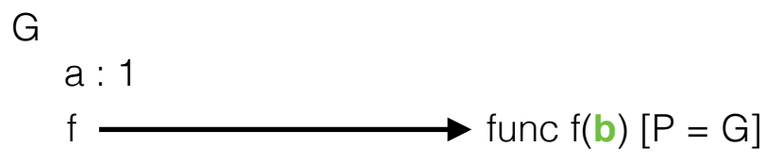

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b: **1**

r.v.: 2

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Solution

G

a : 1

f → func f(**b**) [P = G]

f1: f [P=G]

b: 1

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a : ~~1~~, 2

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f1: f [P=G]

b: **1**

r.v.: 2

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Draw the environment diagram that results from running the following code.

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Solution

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a : ~~1~~, 2

f → func f(**b**) [P = G]

f1: f [P=G]

b: 1

r.v.: 2

f2: f [P=G]

Draw the environment diagram that results from running the following code.

```
a = 1
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a = b(a)
```

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Solution

G

a : ~~1~~, 2

f → func f(**b**) [P = G]

f1: f [P=G]

b: **1**

r.v.: 2

f2: f [P=G]

b: 2

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Solution

G

a : ~~1~~, 2

f → func f(**b**) [P = G]

f1: f [P=G]

b: **1**

r.v.: 2

f2: f [P=G]

b: 2

r.v.: 4

Draw the environment diagram that results from running the following code.

```
a = 1
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a = b(a)
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- the first line is an assignment statement (recall the procedure for assignment statements)

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Solution

G

a : ~~1~~, ~~2~~, 4

f → func f(**b**) [P = G]

f1: f [P=G]

b: **1**

r.v.: 2

f2: f [P=G]

b: 2

r.v.: 4

2.1 #2

Draw the environment diagram that results from running the following code.

```
from operator import add
def sub(a, b):
    sub = add
    return a - b
add = sub
sub = min
print(add(2, sub(2, 3)))
```

Draw the environment diagram that results from running the following code.

```
from operator import add
def sub(a, b):
    sub = add
    return a - b
add = sub
sub = min
print(add(2, sub(2, 3)))
```

Reasoning

Solution

func min(…) [P=G]

Draw the environment diagram that results from running the following code.

```
from operator import add
def sub(a, b):
    sub = add
    return a - b
add = sub
sub = min
print(add(2, sub(2, 3)))
```

Reasoning

- ignore the import
- first line is a def. (write the name and point it at the function signature)

Solution

func min(…) [P=G]

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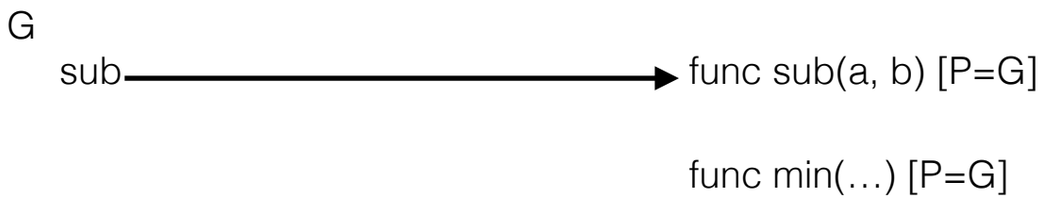

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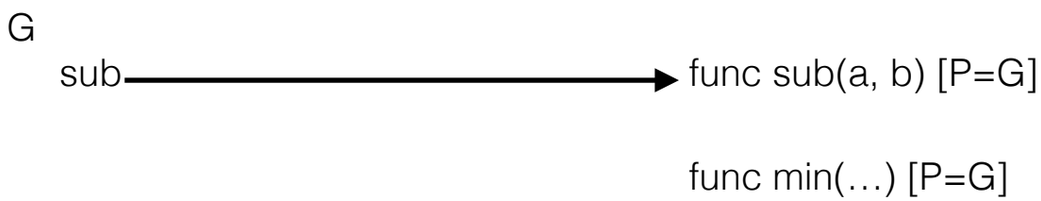
Reasoning

- ignore the import
- first line is a def. (write the name and point it at the function signature)
- `add = sub` is an assignment. whats the value of the LHS? what name do we assign to this value?

Solution



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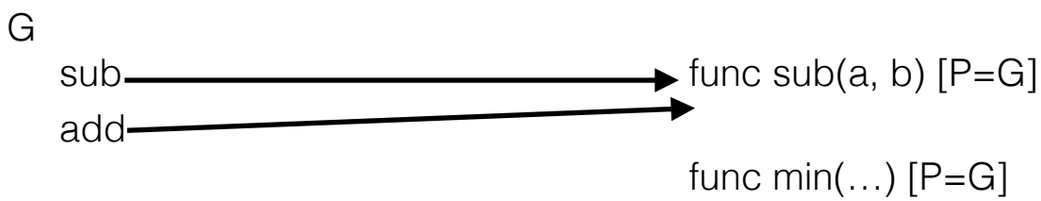

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- first line is a def. (write the name and point it at the function signature)
- `add = sub` is an assignment. whats the value of the LHS? what name do we assign to this value?
- `sub = min` is another assignment. whats the **value**? whats the **name**? recall that we cannot have the same name bound to 2 values in the same **frame**

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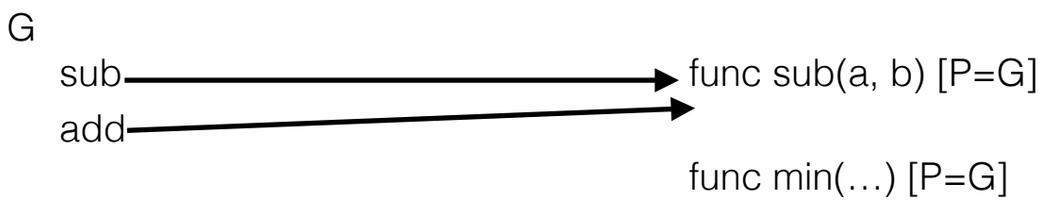

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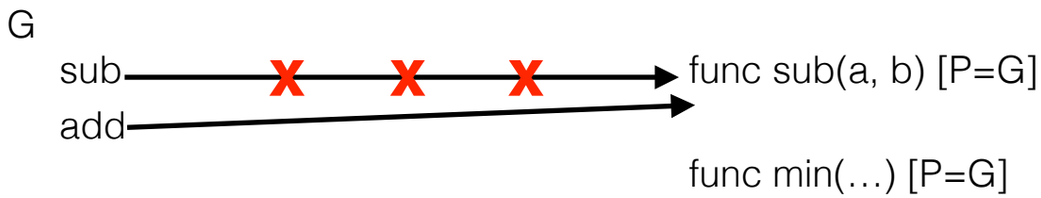

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from operator import add
def sub(a, b):
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    return a - b
add = sub
sub = min
print(add(2, sub(2, 3)))
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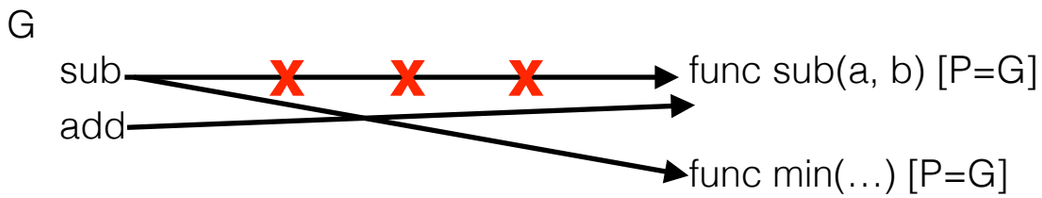

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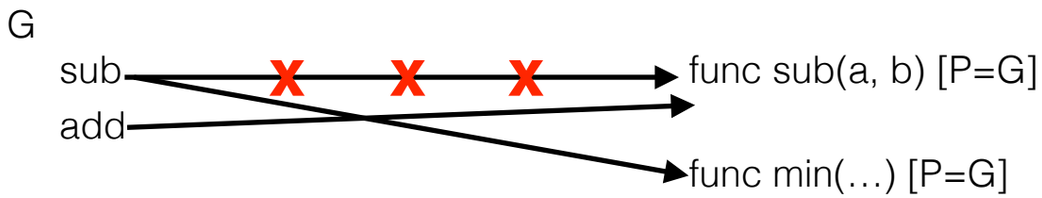

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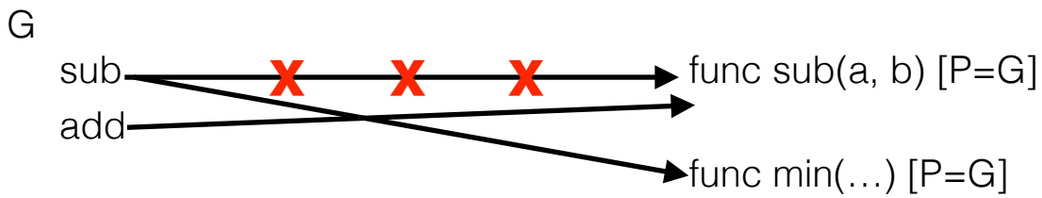

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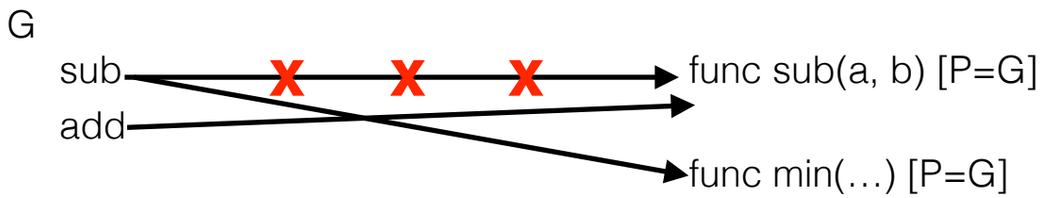

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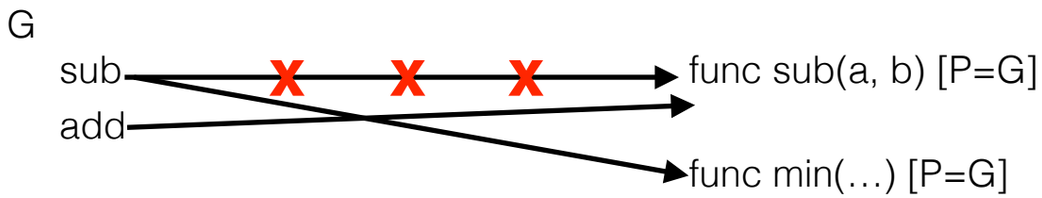

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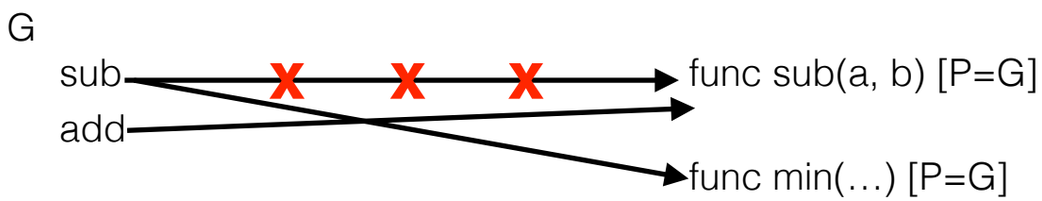

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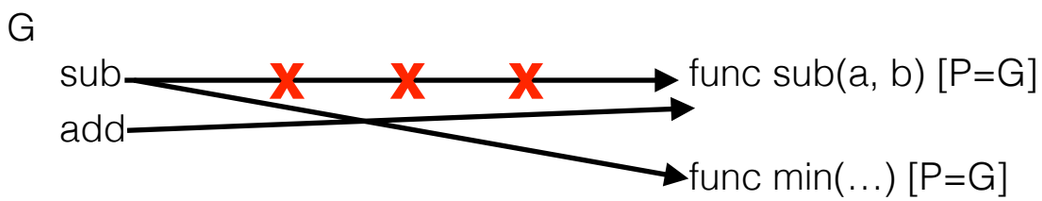

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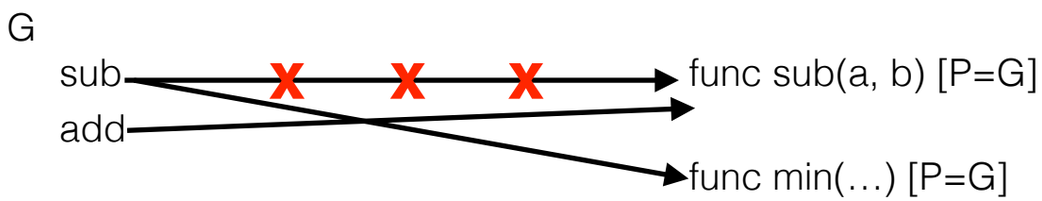

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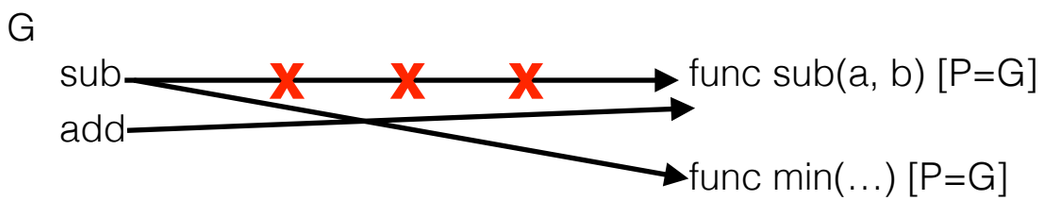

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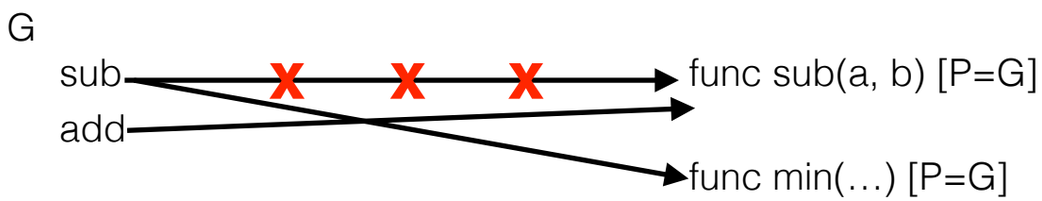

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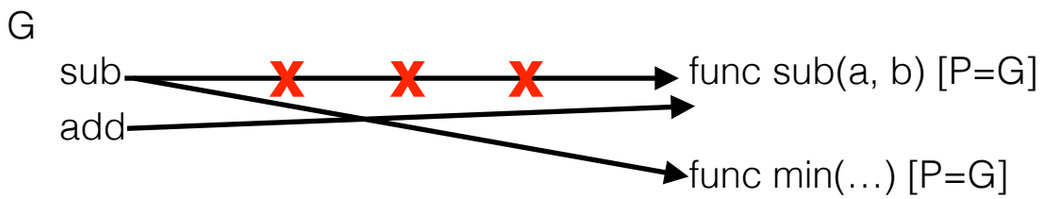

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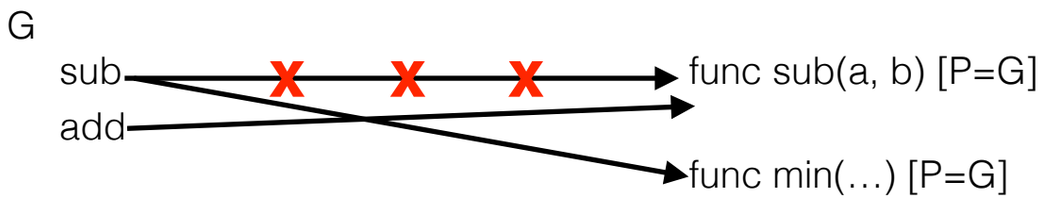

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  next is add, which is really sub. we pass in 2 and 2

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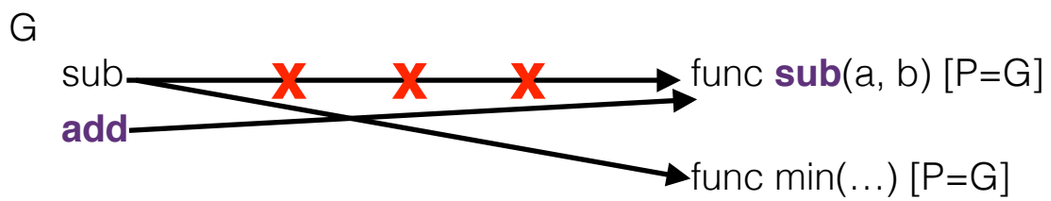

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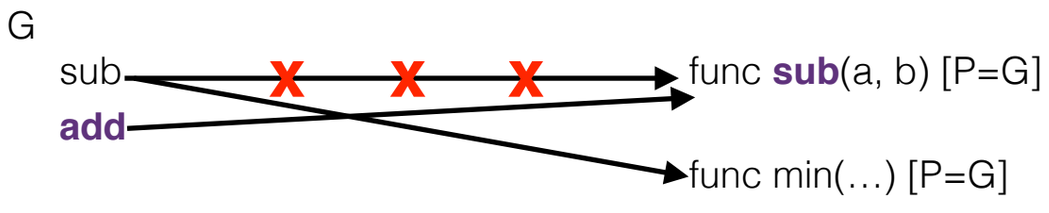

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  b: 2

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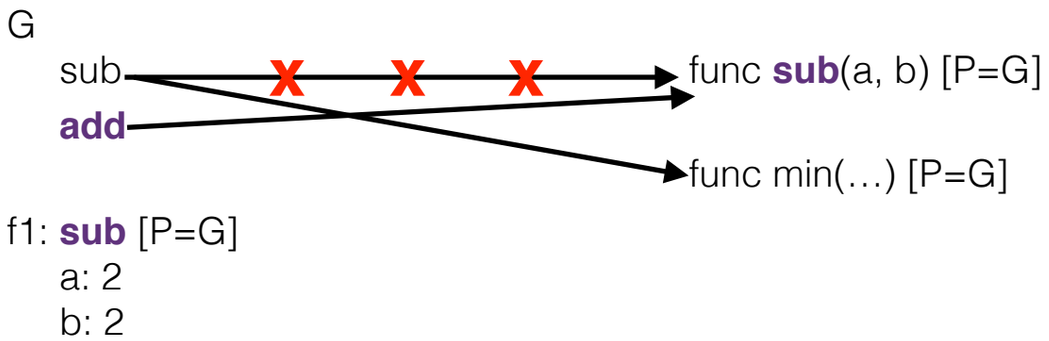

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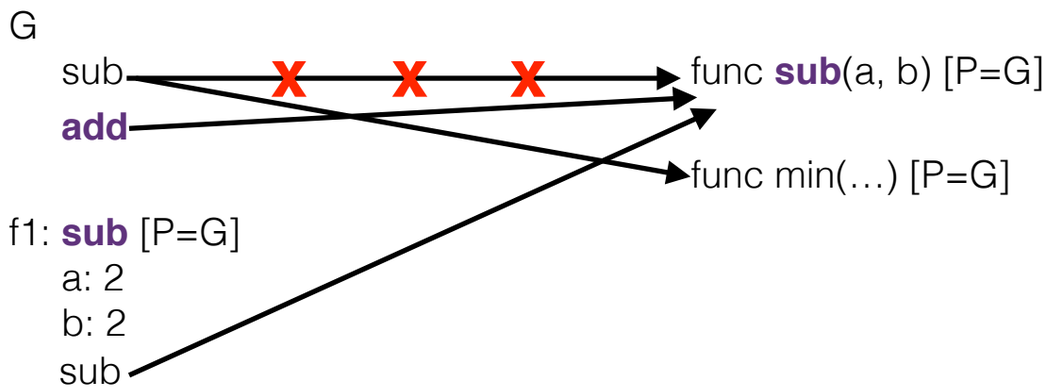

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- what do we return from sub? whats a? whats b?

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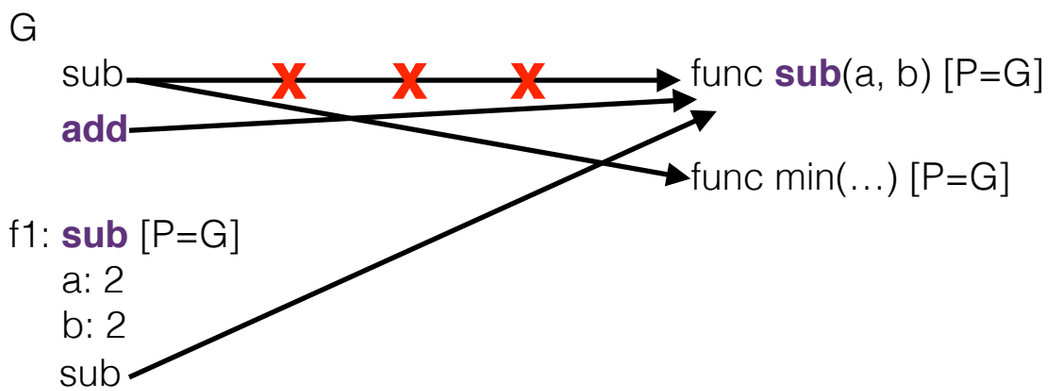

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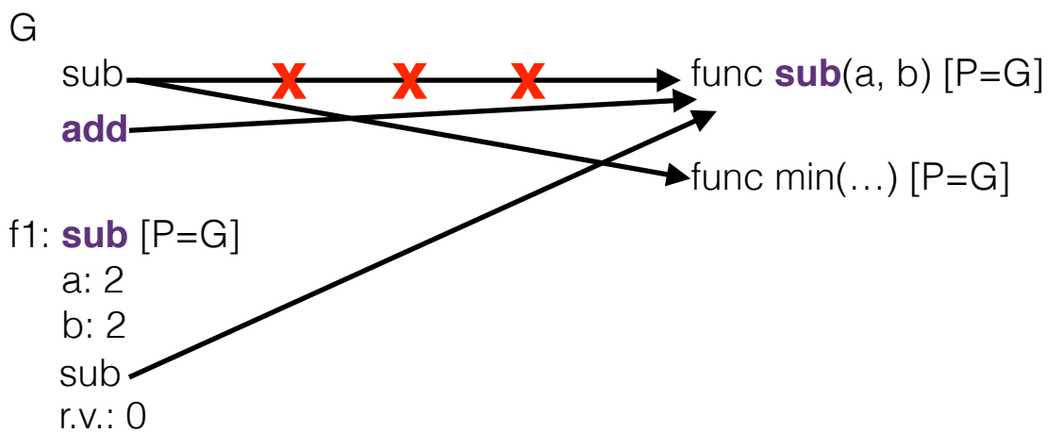

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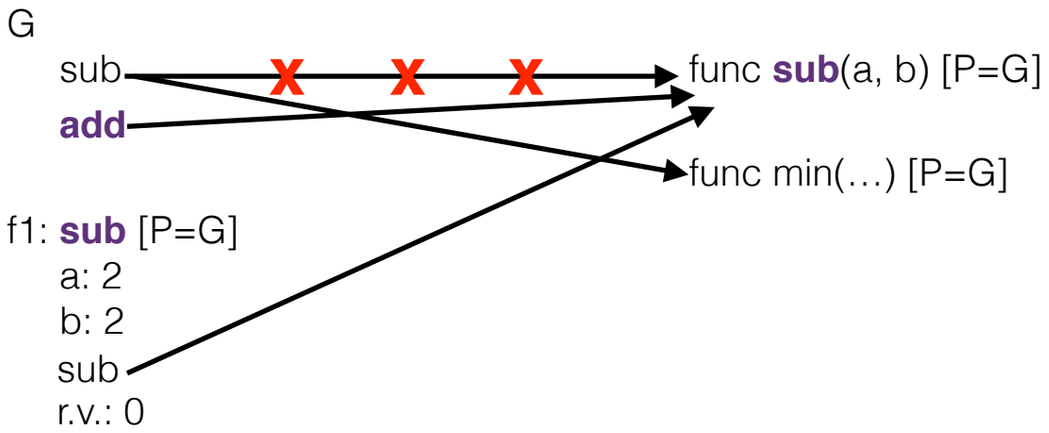

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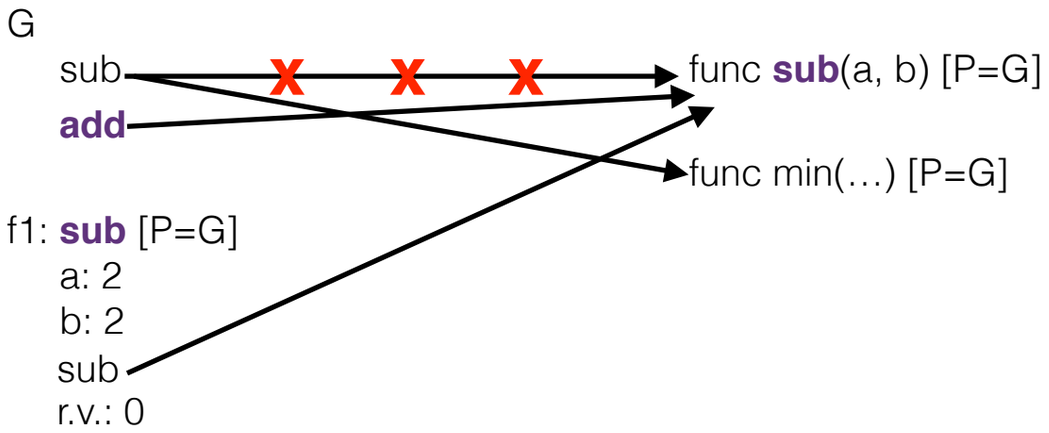
  the LHS says sub, so we must bind the name sub

- what do we return from sub? whats a? whats b? a=2, b=2 —> a - b = 0
- finally, what do we print?

Solution



Draw the environment diagram that results from running the following code.

```
from operator import add
def sub(a, b):
    sub = add
    return a - b
add = sub
sub = min
print(        0          )
```

Reasoning

- ignore the import
- first line is a def. (write the name and point it at the function signature)
- add = sub is an assignment. whats the value of the LHS? what name do we assign to this value?
- sub = min is another assignment. whats the value? whats the name? recall that we cannot have the same name bound to 2 values in the same **frame**
- now we will walk through the order of function calls. remember, operator then operands!
- what's the first function we call? what's that functions intrinsic name? do we need to draw a frame for this function?

  the first function we call is sub, which is really min.
  min is built in so we do not need to draw a frame.

- what's the next function we call? what's its intrinsic name? what arguments do we pass in?

  next is add, which is really sub. we pass in 2 and 2

- now we are ready to execute the body of the function. `sub = add` is an assignment statement. whats the value of the RHS? what name do we bind?

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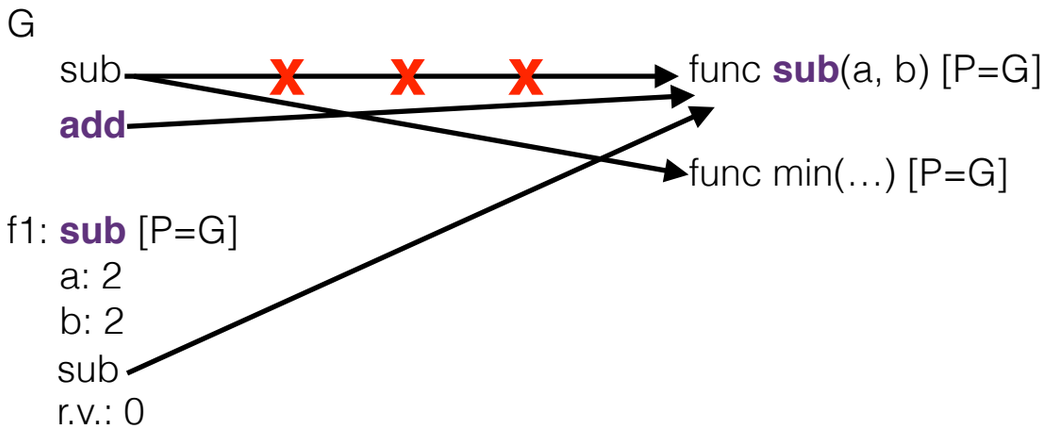

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What is a higher order function?

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x = 2
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outer(1)(3)
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so when inner looks for x, it will look in its parent (outer)

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note this is different from the code on the left!

Code on the left will print 1. Code on the right will print 2.

3.4 #1

What will Python display?

```
def outer(n):
    def inner(m):
        return n - m
    return inner
```

```
>>> outer(61)
```

```
>>> f = outer(10)
>>> f(4)
```

```
>>> outer(5)(4)
```

Reasoning

What will Python display?

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Reasoning

- first we call `outer`. what do we pass in as the argument?

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we pass in 61.

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Reasoning

- first we call `outer`. what do we pass in as the argument?

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- now we are ready to execute the body of `outer`. the first thing we encounter is another function definition

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  n is 10, m is 4. n - m = 10 - 4 = 6

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- try the last line! keep track of what n and m are

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4

- what is n - m?

n is 10, m is 4. n - m = 10 - 4 = 6

- try the last line! keep track of what n and m are

What will Python display?

```
def outer(n):
    def inner(m):
        return n - m
    return inner
```

```
>>> outer(61)
```

<func …>

```
>>> f = outer(10)
>>> f(4)
```

6

```
>>> outer(5)(4)
```

5

Reasoning

- first we call `outer`. what do we pass in as the argument?

we pass in 61.

- now we are ready to execute the body of `outer`. the first thing we encounter is another function definition

- after defining `inner`, we encounter the line: `return inner`
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3.2 #1

Write a function that takes in a function `cond` and number `n` and prints the numbers from `1` to `n` for which calling `cond` on that number returns `true`.

```
def keep_ints(cond, n):
```

Reasoning

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use these facts to help you write a solution

Write a function that takes in a function `cond` and number `n` and prints the numbers from `1` to `n` for which calling `cond` on that number returns `true`.

```
def keep_ints(cond, n):
    k = 1
    while k <= n:
        if cond(k):
            print(k)
        k += 1
```

Reasoning

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3.4 #2

Write a function that takes in a function a number `n` and returns another function that takes in one parameter `cond`. The returned function prints the numbers from `1` to `n` for which calling `cond` on that number returns `true`.

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def keep_ints(n):
```

Reasoning

Write a function that takes in a function a number `n` and returns another function that takes in one parameter `cond`. The returned function prints the numbers from `1` to `n` for which calling `cond` on that number returns `true`.

```
def keep_ints(n):
```

Reasoning

- this is very similar to what we just did!

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Reasoning

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- what does the returned function do?
does this sound familiar?

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def keep_ints(n):
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  the returned function does exactly what `keep_ints` used to do

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- instead of keep_ints doing the work, `keep_ints` will define a function that does that work for us

Write a function that takes in a function a number `n` and returns another function that takes in one parameter `cond`. The returned function prints the numbers from `1` to `n` for which calling `cond` on that number returns `true`.

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```
def keep_ints(n):
    def do_work(cond):
```

Reasoning

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def keep_ints(n):
    def do_work(cond):
```

```
    return do_work
```

Reasoning

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- what does the returned function do? does this sound familiar?
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        k = 1
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            k += 1
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Reasoning

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