CS61A Notes – Week 6: Nonlocal Assignment, Local State, and More Environments!!

Solutions to Exercises

QUESTIONS

1.) What Would Python Print (WWPP)
For the following exercises, write down what Python would print. If an error occurs, just write 'Error', and briefly describe the error.

a.)
```
>>> name = 'rose'
>>> def my_func():
...     name = 'martha'
...     return None
>>> my_func()
>>> name
______ ?
```

[**Solution**]:
rose

b.)
```
>>> name = 'ash'
>>> def abra(age):
...     def kadabra(name):
...         def alakazam(level):
...             nonlocal name
...             name = 'misty'
...             return name
...         return alakazam
...     return kadabra
>>> abra(12)('sleepy')(15)
______ ?
>>> name
______ ?
```

[**Solution**]:
misty
ash

c.)
```
>>> ultimate_answer = 42
>>> def ultimate_machine():
...     nonlocal ultimate_answer
...     ultimate_answer = 'nope!'
...     return ultimate_answer
>>> ultimate_machine()
______ ?
>>> ultimate_answer
______ ?
```

[**Solution**]:
Error (can't have a nonlocal variable refer to a global variable)
42

d.)

```
>>> def f(t=0):
...     def g(t=0):
...         def h():
...             nonlocal t
...             t = t + 1
...         return h, lambda: t
...     h, gt = g()
...     return h, gt, lambda: t

>>> h, gt, ft = f()
>>> ft(), gt()
______ ?
>>> h()
>>> ft(), gt()
______ ?
```

[**Solution**]:
(0, 0)
(0, 1)

More Environment Diagrams!

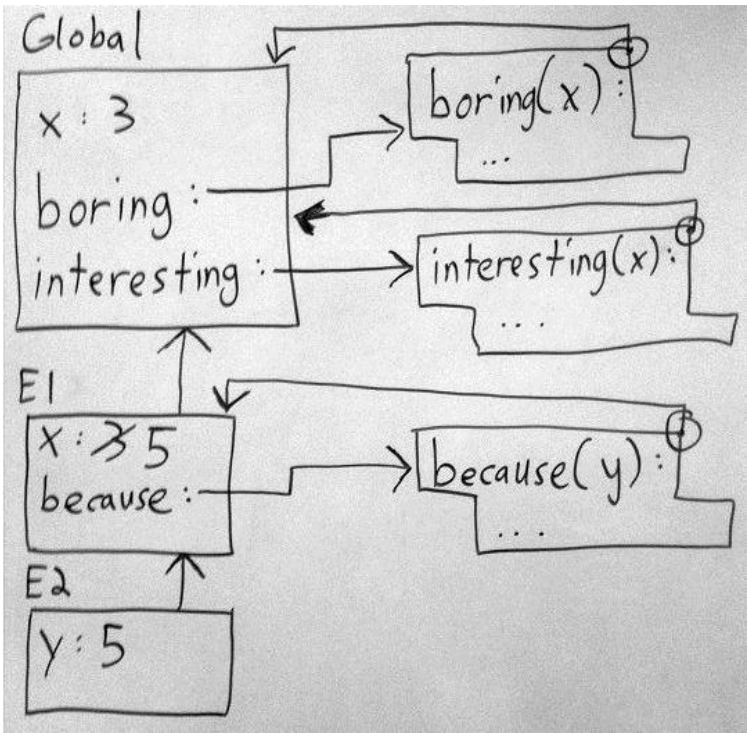
1.) Draw the environment diagram for each of the following, and write return values where prompted:

a.)

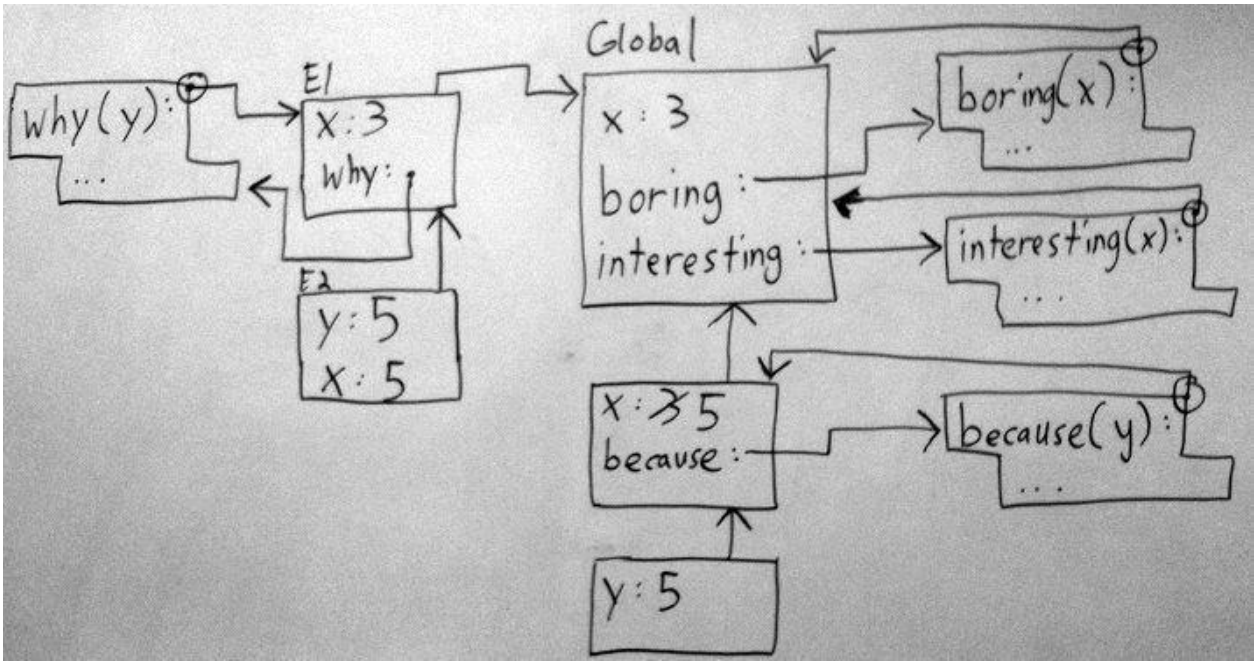
```
x = 3

def boring(x):
    def why(y):
        x = y
    why(5)
    return x

def interesting(x):
    def because(y):
        nonlocal x
        x = y
    because(5)
    return x

interesting(3)
________

boring(3)
________
```

[**Solution**]:
5
3

First:



Then:

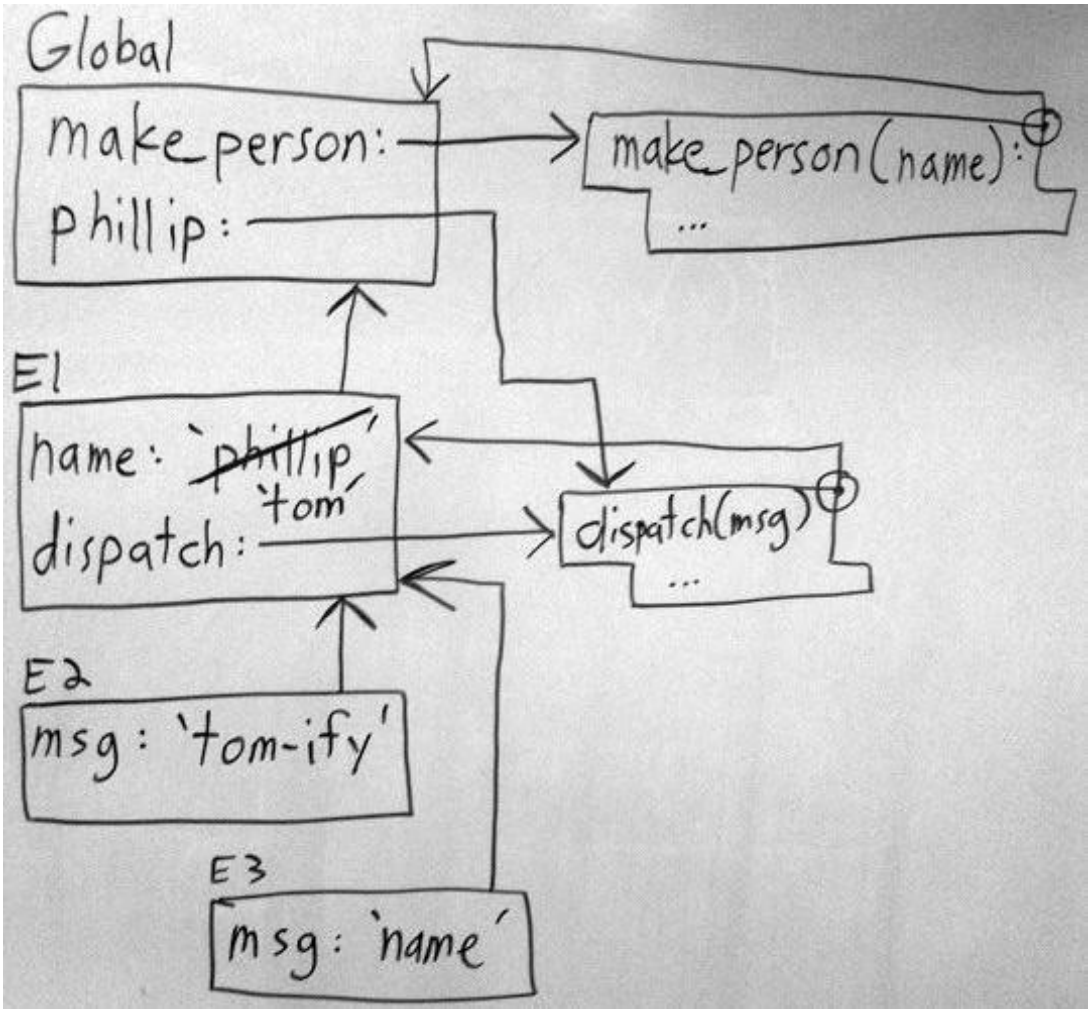


b.)

```
def make_person(name):
    def dispatch(msg):
        nonlocal name
        if msg == 'name':
            return name
        elif msg == 'tom-ify':
            name = 'tom'
        else:
            print("wat")
    return dispatch

>>> phillip = make_person('phillip')
>>> phillip('tom-ify')
>>> phillip('name')
```

[**Solution**]:

tom



2.) Recall that, earlier in the semester, we represented numerical sequences as a function of one argument (taking in the index). If we want to process the elements of such a sequence, it'd be nice to have a function that 'remembers' where in the sequence it is in.

For instance, consider the `evens` function:

```
def evens(n):
    """ Return the n-th even number. """
    return 2 * n
```

I'd like to have a function `generate_evens` that spits out the even numbers, one by one:

```
>>> generate_evens = make_seq_generator(evens)
>>> for i in range(4):
...     print(generate_evens())
0
2
4
6
```

Write a function `make_seq_generator` that, given a function `fn`, returns a new function that returns the elements of the sequence one by one (like in the above example):

[**Solution**]:

```
def make_seq_generator(seq_fn):
    cur_idx = 0
    def generator():
        nonlocal cur_idx
        result = seq_fn(cur_idx)
        cur_idx += 1
        return result
    return generator
```

3.) Let's implement counters, in the dispatch-procedure style!

a.) Write a procedure `make_counter` that returns a function that behaves in the following way:

```
>>> counter1 = make_counter(4)
>>> counter2 = make_counter(42)
>>> counter1('count')
5
>>> counter1('count')
6
>>> counter2('count')
43
>>> counter2('reset')
0
>>> counter1('count')
7
```

To help jog your memory, here's the skeleton of `make_counter`:

```
def make_counter(start_val):
    def dispatch(msg):
        if msg == ...
        ...
    return dispatch
```

[**Solution**]:

```
def make_counter(start):
   value = start
   def dispatch(msg):
       nonlocal value
       if msg == 'count':
           value += 1
           return value
       elif msg == 'reset':
            value = 0
            return value
       else:
            return 'Unknown message'
   return dispatch
```

b.) Modify your answer to (a) to include support for a new message, `'clone'`, that returns a copy of the current counter. The clone should be independent of the original:

```
>>> counter = make_counter(3)
>>> counter('count')
4
>>> clone = counter('clone')
>>> clone('count')
5
>>> counter('reset')
0
>>> clone('count')
6
```

```
def make_counter(start):
   value = start
   def dispatch(msg):
       nonlocal value
       if msg == 'count':
           value += 1
           return value
       elif msg == 'reset':
            value = 0
            return value
       elif msg == 'clone':
            return make_counter(value)
       else:
            return 'Unknown message'
   return dispatch
```