Expressions

QUESTIONS

1. Determine the result of evaluating `f(4)` in the Python interpreter if the following functions are defined:

```
from operators import add
def double(x):
   return x + x

def square(y):
   return y * y

def f(z):
   add(square(double(z)), 1)

f(4)
```

None!
But if we include the return keyword under the definition of f the answer is 65.

Pure Functions vs. Non-Pure Functions (pay attention to domain and range!)

QUESTIONS

2. What do you think Python will print for the following? Assume this definition of the `om` and `nom` procedure:

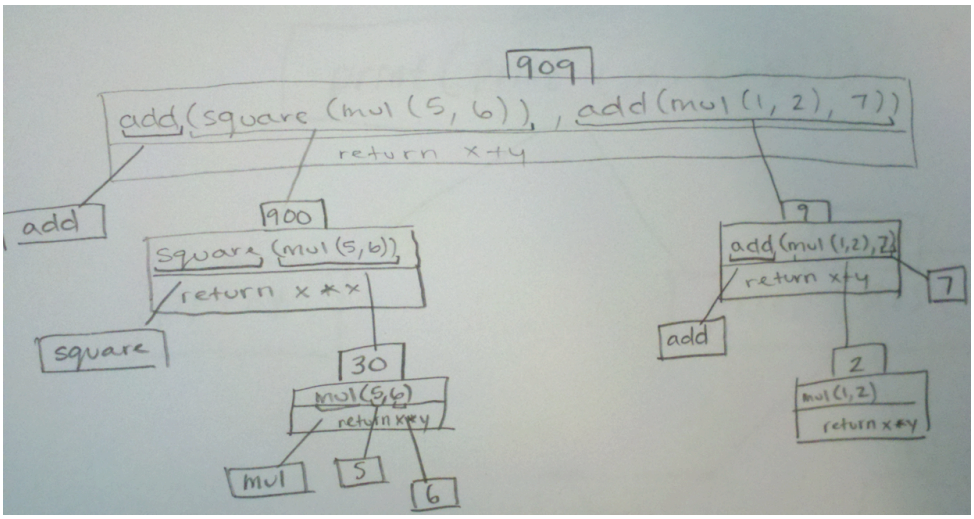
```
def om(foo):
    return -foo

def nom(foo):
    print(foo)
```

```
>>> nom(4)
4
>>> om(-4)
4
>>> save1 = nom(4)
4
>>> save1 + 1
error
>>> save2 = om(-4)
>>> save2 + 1
5
```

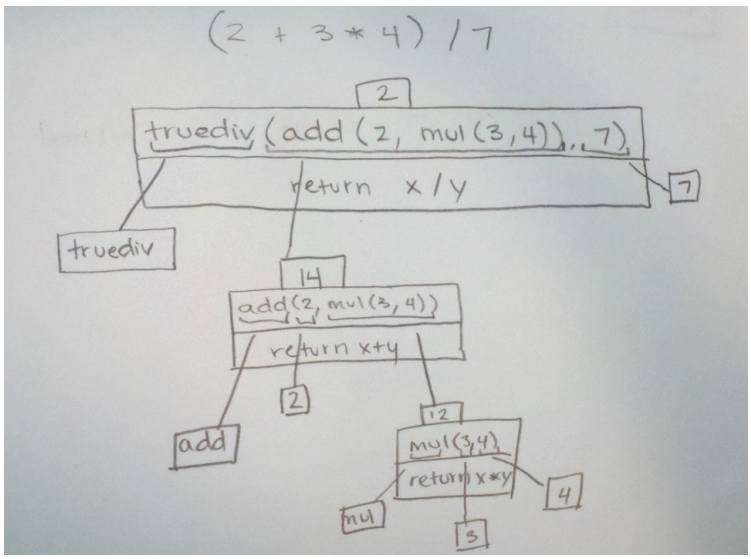
Expression Trees

QUESTIONS

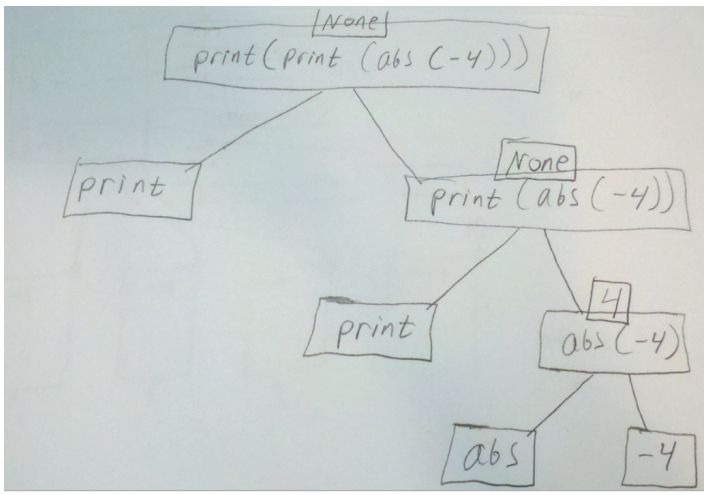
3. `add(square(mul(5, 6)), add(mul(1, 2), 7))`



4. `(2 + 3 * 4) / 7`



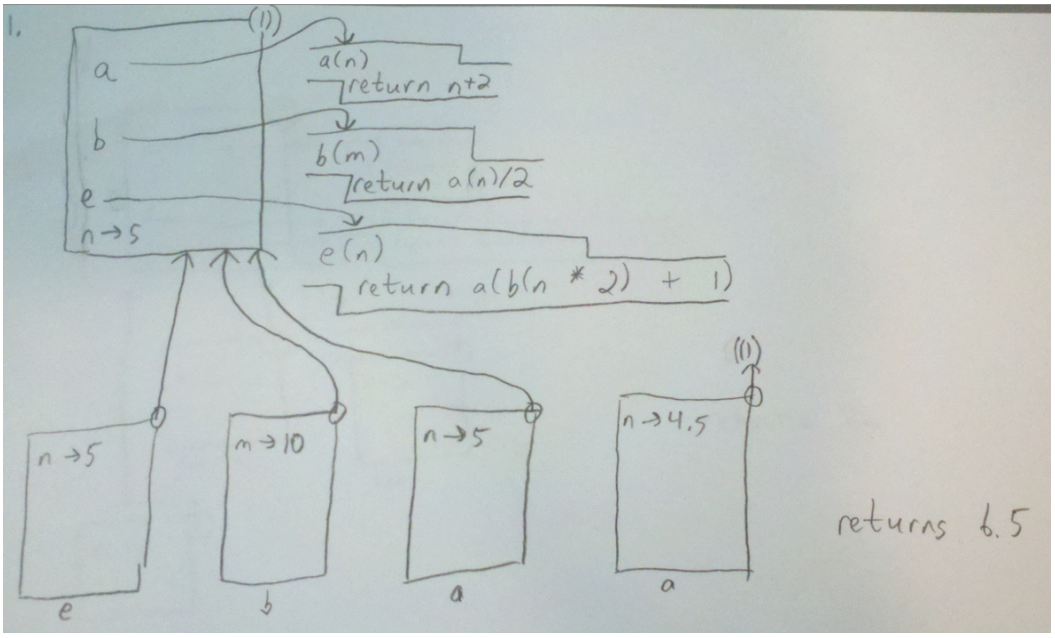
5. `print(print(abs(-4)))`



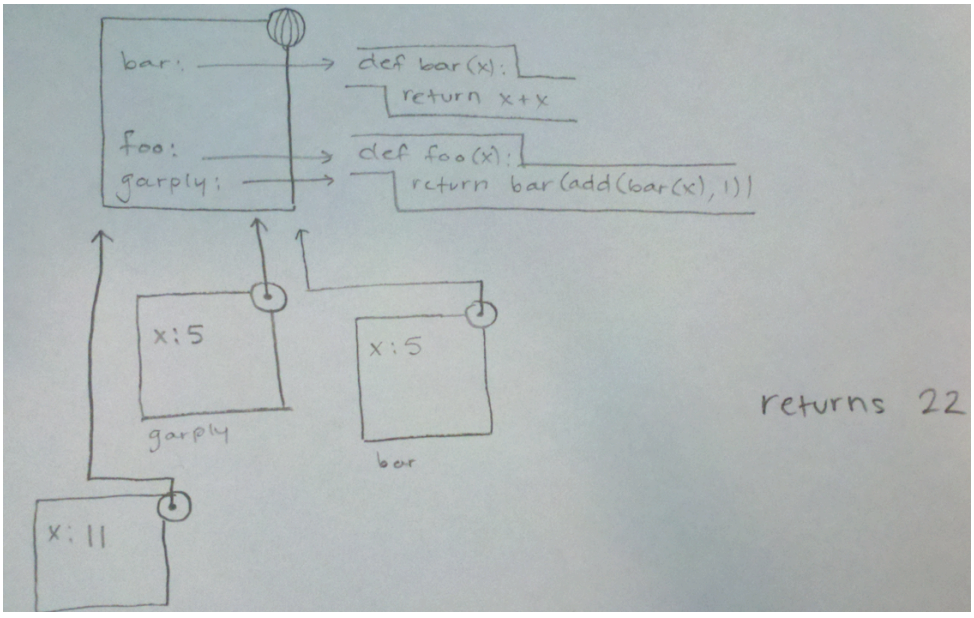
First Edition Environment Diagrams

Fill out the environment diagram, the environments and values as well as the expression tree, for the following code:

1.
```
>>> def a(n):
...     return n + 2
>>> def b(m):
...     return a(n)/2
>>> def e(n):
...     return a(b(n * 2) + 1)
>>> n = 5
>>> e(n)
6.5
```



2.
```
>>> def bar(x):
...     return x + x
>>> def foo(x):
...     return bar(add(bar(x),1))
>>> garply = foo
>>> garply(5)
22
```



Procedures as arguments

```
def double_every_number(n):
    i = 1
    while n >= i:
        print(double(i))
        i += 1

def square_every_number(n):
    i = 1
    while n >= i:
        print(square(i))
        i += 1
```

QUESTIONS

1. Now implement the function `every` which takes in a function `func` and a number `n`, and applies that function to the first n numbers from 1 and prints the result along the way:

   ```
   def every(func, n):
       i = 1
       while n >= i:
           print(func(i))
           i += 1
   ```

2. Similarly, try implementing the function `keep`, which takes in a predicate pred and a number n, and only prints a number from 1 to n to the screen if it fulfills the predicate:

   ```
   def keep(pred, n):
       i = 1
       while n >= i:
           if pred(i):
               print(i)
           i += 1
   ```

Procedures as return values

QUESTIONS

Draw the expression tree for the following expression calls assuming we have imported the correct functions.

3. Write a procedure `and_add_one` that takes a function `f` as an argument (such that `f` is a function of one argument). It **should return a function** that takes one argument, and does the same thing as `f`, except adds one to the result.

   ```
   def and_add_one(f):
       def new_function(x):
           return f(x) + 1
       return new_function
   ```

4. Write a procedure `and_add` that takes a function `f` and a number `n` as arguments. It **should return a function** that takes one argument, and does the same thing as the function argument, except adds `n` to the result.

```
def and_add(f, n):
    def new_func(x):
        return f(x) + n
    return new_func
```

5. Python represents a programming community, and in order for things to run smoothly, there are some standards in order to keep things consistent. The following is the recommended style for coding so that collaboration with other python programmers becomes standard and easy. Write your code at the very end:

```
def identity(x):
   return x

def lazy_accumulate(f, start, n, term):
    """
    Takes the same arguments as accumulate from homework and
    returns a function that takes a second integer m and will
    return the result of accumulating the first n numbers
    starting at 1 using f and combining that with the next m
    integers.

    Arguments:
    f - the function fqor the first set of numbers.
    start - the value to combine with the first value in the
            sequence.
    n - the stopping point for the first set of numbers.
    term - function to be applied to each number before combining.

    Returns:
    A function (call it h) h(m) where m is the number of
    additional values to combine.

    >>> # This does (1 + 2 + 3 + 4 + 5) + (6 + 7 + 8 + 9 + 10)
    >>> lazy_accumulate(add, 0, 5, identity)(5)
    55
    """
def second_accumulate(m):
    return accumulate(f, 0, n + m, term)
return second_accumulate
```