FINAL REVIEW

COMPUTER SCIENCE MENTORS 61A

April 25 to April 29, 2016

1 What Would Python Print? Iterators

1.
```
class SkipIterator:
    def __init__(self, rng, n):
        self.obj = rng
        self.skip = n

    def __iter__(self):
        return self

    def __next__(self):
        result = self.obj.curr
        self.obj.curr += self.skip
        return result

class SkippedNaturals:
    def __init__(self):
        self.curr = 0
        self.skip = 1

    def __iter__(self):
        return SkipIterator(self, self.skip)
```

Expression	Interactive Output

`p = SkippedNaturals()`
`twos = iter(p)`
`p.skip = p.skip + 1`
`threes = iter(p)`
`next(twos)`	

`next(twos)`	
`next(threes)`	
`next(threes)`	

2 Environment Diagrams

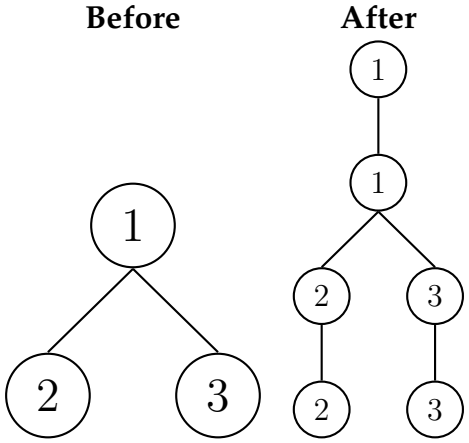
2. Draw the environment diagram for the following code snippet:

```
def one(two):
    three = two
    def four(five):
        nonlocal three
        if len(three) < 1:
            three.append(five)
            five = lambda x: four(x)
        else:
            five = seven + 7
        return five
    two = two + [1]
    seven = 8
    return four(three)

eight = one([])
print(eight(9))
```

3 Recursive Data Structures

3. DoubleTree hired you to architect one of their hotel expansions! As you might expect, their floor plan can be modeled as a tree and the expansion plan requires doubling each node (the patented double tree floor plan). Here's what some sample expansions look like:



Fill in the implementation for `double_tree`.

```
def double_tree(t):
    """
    Given a tree, return a new tree where entries appear
    twice.
    >>> double_tree(Tree(1))
    Tree(1, [Tree(1)])
    >>> double_tree(Tree(1, [Tree(2), Tree(3)]))
    Tree(1, [Tree(1, [Tree(2, [Tree(2)]),
                      Tree(3, [Tree(3)])
                     ])
            ])
    """
```

4. Fill in the implementation of `double_link`.

```
def double_link(lst):
    """
    Using mutation, replaces the second in each pair of items
    with the first. The first of each pair stays as is.
    >>> double_link(Link(1, Link(2, Link(3, Link(4)))))
    Link(1, Link(1, Link(3, Link(3))))
    >>> double_link(
            Link('c', Link('s', Link(6, Link(1, Link('a'))))))
        )
    Link('c', Link('c', Link(6, Link(6, Link('a')))))
    """
    if _____________________________________________:
        return
    _____________________________________________
    _____________________________________________
    return _____________________________________________
```

5. Fill in the implementation of `shuffle`.

```
def shuffle(lst):
    """
    Swaps each pair of items in a linked list.
    >>> shuffle(Link(1, Link(2, Link(3, Link(4)))))
    Link(2, Link(1, Link(4, Link(3))))
    >>> shuffle(
            Link('s', Link('c', Link(1, Link(6, Link('a'))))))
        )
    Link('c', Link('s', Link(6, Link(1, Link('a')))))
    """
    if _____________________________________________________
        return _____________________________________________
    new_head = lst.rest
    lst.rest = _____________________________________________
    _____________________________________________________
    return _____________________________________________________
```

4 Scheme

6. Write a Scheme function insert that creates a new list that would result from inserting an item into an existing list at the given index. Assume that the given index is between 0 and the length of the original list, inclusive.

```
(define (insert lst item index)




)
```

Extra: Write this as a tail recursive function. Assume append is tail recursive.

5 Interpreters

7. Circle the number of calls to `scheme_eval` and `scheme_apply` for the code below.

```
(define (square x) (* x x))
(+ (square 3) (- 3 2))
```

Calls to `scheme_eval` (circle one)	2	5	14	24
Calls to `scheme_apply` (circle one)	1	2	3	4

6 Recursive Select in SQL

8. Create a `mod_seven` table that has two columns, a number from 0 to 100 and then its value mod 7.
Hint: You can create a table first with all of the initial data you will build from, and then build the `mod_seven` table.

7 Iterators, Generators, and Streams

9. Write a generator that will take in two iterators and will compare the first element of each iterator and yield the smaller of the two values.

```
def interleave(iter1, iter2):
    """
    >>> gen = interleave(iter([1, 3, 5, 7, 9]),
                         iter([2, 4, 6, 8, 10]))
    >>> for elem in gen:
    ...     print(elem)
    ...
    1
    2
    3
    4
    5
    6
    7
    8
    9
    """
```

10. **Food Planning Scheme**

(a) You and your 61A friends are cons. You cdr'd just studied for the final, but instead you scheme to drive away across a stream in a car during dead week. Of course, you would like a variety of food to eat on your roadtrip.

Write a stream that takes in a list of foods and outputs each food, looping back to the first food in the list when the list is exhausted.

Write an infinite stream that takes in a list of foods and loops back to the first food in the list when the list is exhausted. **Bonus:** Count all the puns in this question!

```
(define (food-stream foods)




)
```

(b) We discover that some of our food is stale! Every other food that we go through is stale, so put it into a new stale food stream. Assume `is-stale` starts off at 0.

```
(define (stale-stream foods is-stale)




)
```