GENERATORS AND STREAMS

COMPUTER SCIENCE MENTORS 61A

April 16 to April 18, 2018

1 Iterators and Generators

1. What does the following code block output?

```
def foo():
    a = 0
    if a < 10:
        print("Hello")
        yield a
        print("World")

for i in foo():
    print(i)
```

2. How can we modify `foo` so that `list(foo())== [0, 1, 2, . . . , 9]`? (It's okay if the program prints along the way.)

3. Define `hailstone_sequence`, a generator that yields the hailstone sequence. Remember, for the hailstone sequence, if `n` is even, we need to divide by two. Otherwise, we multiply by 3 and add by 1.

```
def hailstone_sequence(n):
    """
    >>> hs_gen = hailstone_sequence(10)
    >>> next(hs_gen)
    10
    >>> next(hs_gen)
    5
    >>> for i in hs_gen:
            print(i)
    16
    8
    4
    2
    1
    """
```

4. Define `tree_sequence`, a generator that iterates through a tree by first yielding the root value and then yielding the values from each branch.

```
def tree_sequence(t):
    """
    >>> t = Tree(1, [Tree(2, [Tree(5)]), Tree(3, [Tree(4)])])
    >>> print(list(tree_sequence(t)))
    [1, 2, 5, 3, 4]
    """
```

2 Streams

1. What are the differences between streams and scheme lists? What's the advantage of using a stream over a linked list?

2. What's the maximum size of a stream?

3. When is the next element actually calculated?

4. What Would Scheme Display?

(a) `scm> (define x 1)`

(b) `scm> (define p (delay (+ x 1)))`

(c) `scm> p`

(d) `scm> (force p)`

(e) `scm> (define (foo x)(+ x 10))`

(f)
```
scm> (define bar (cons-stream (foo 1)
                              (cons-stream (foo 2) bar)))
```

(g) `scm> (car bar)`

(h) `scm> (cdr bar)`

(i) `scm> (define (foo x)(+ x 1))`

(j) `scm> (cdr-stream bar)`

(k) `scm> (define (foo x)(+ x 5))`

(l) `scm> (car bar)`

(m) `scm> (cdr-stream bar)`

Computer Science Mentors CS61A Spring 2018: Chris Allsman and Jennie Chen, with
Ajay Raj, Alex Yang, Annie Tang, Brandon Fong, Catherine Han, Danelle Nachum, Elaine Park, Hyun Jae Moon,
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Thomas Zhang

3 Code Writing for Streams

1. Implement `double_naturals`, which is a stream that evaluates to the sequence 1, 1, 2, 2, 3, 3, etc.

```
(define (double-naturals)
     (double-naturals-helper 1 #f)
)
(define (double-naturals-helper first go-next)





)
```

2. Implement `interleave`, which returns a stream that alternates between the values in stream1 and stream2. Assume that the streams are infinitely long.

```
(define (interleave stream1 stream2)





)
```

4 Challenge Question

1. **(Optional)** Write a generator that takes in a tree and yields each possible path from root to leaf, represented as a list of the values in that path. Use the object-oriented representation of trees in your solution.

```
def all_paths(t):
    """
    >>> t = Tree(1, [Tree(2, [Tree(5)]), Tree(3, [Tree(4)])])
    >>> print(list(all_paths(t)))
        [[1, 2, 5], [1, 3, 4]]
    """
    if _____________:

        yield ________________

    for ___________________:

        for ________________________:

            _____________________________
```

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