

61A Lecture 31

Friday, November 14

Announcements

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- Project 4 due Friday 11/21 @ 11:59pm

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- Homework 9 (6 pts) due Wednesday 11/26 @ 11:59pm

Information Hiding

Attributes for Internal Use

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class FibIter:
    """An iterator over Fibonacci numbers."""
    def __init__(self):
        self._next = 0
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>>> [next(fibs) for _ in range(10)]
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Starting a name with *two underscores* enforces restricted access from outside the class

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def fib_generator():
    """A generator function for Fibonacci numbers.

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    """  
    yield 0  
    previous, current = 0, 1  
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There is no way to access values bound to "previous" and "current" externally

Singleton Objects

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Streams

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Link(,)

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Stream(,)

First element can be anything

Streams are Lazy Recursive Lists

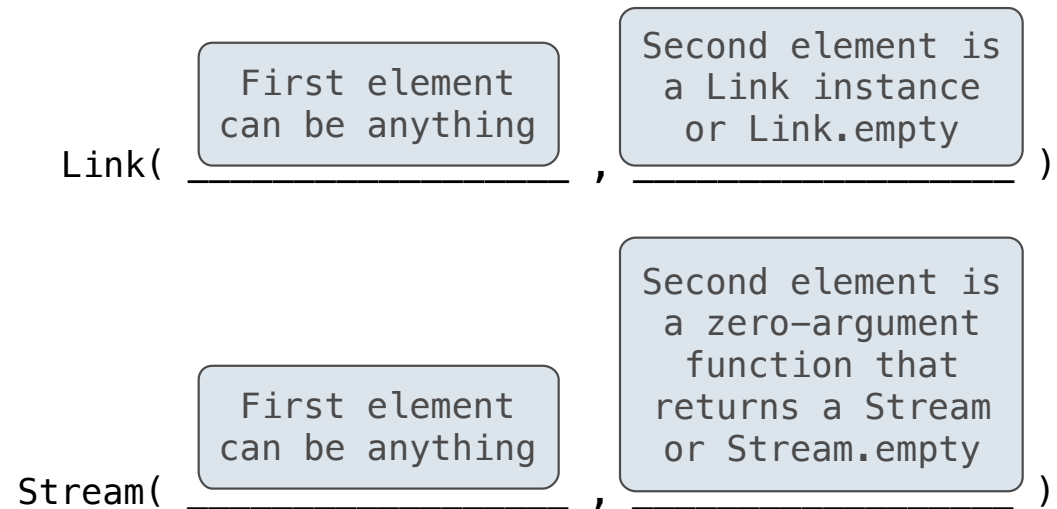
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Link(First element can be anything , Second element is a Link instance or Link.empty)

Stream(First element can be anything , Second element is a zero-argument function that returns a Stream or Stream.empty)

Streams are Lazy Recursive Lists

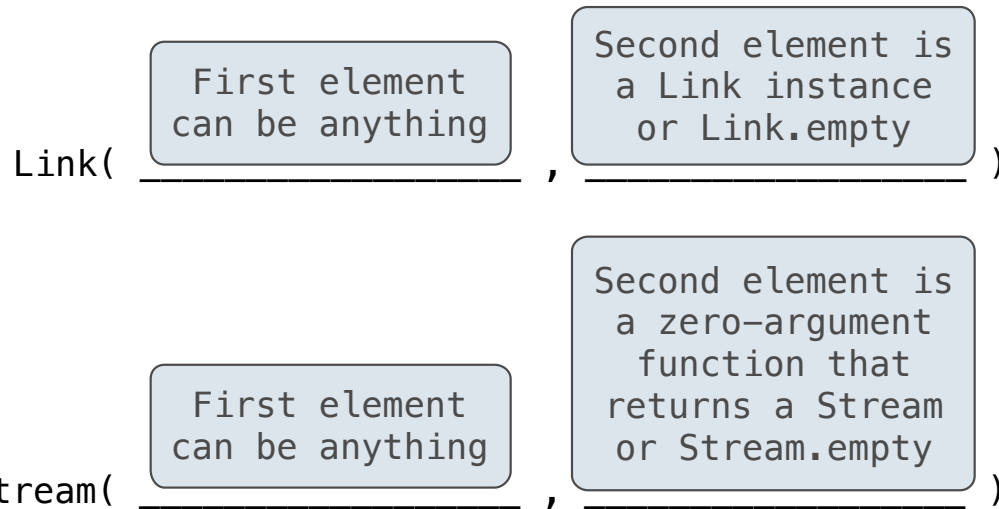
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(Demo)

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```
def integer_stream(first=1):  
    """Return a stream of consecutive integers, starting with first.  
  
    >>> s = integer_stream(3)  
    >>> s.first  
    3  
    >>> s.rest.first  
    4  
    """"  
  
    def compute_rest():  
        return integer_stream(first+1)  
    return Stream(first, compute_rest)
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    class empty:
        def __repr__(self):
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    class empty:
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        assert callable(compute_rest), 'compute_rest must be callable.'
        self.first = first
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    @property
    def rest(self):
        """Return the rest of the stream, computing it if necessary."""
        if self._compute_rest is not None:
            self._rest = self._compute_rest()
            self._compute_rest = None
        return self._rest
```

Higher-Order Functions on Streams

Mapping a Function over a Stream

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Mapping a function over a stream applies a function only to the first element right away; the rest is computed lazily

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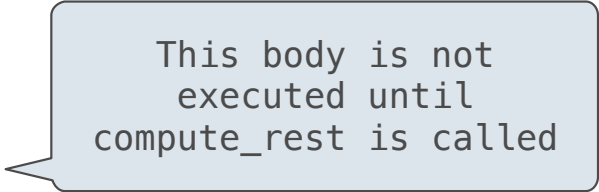
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```
def map_stream(fn, s):
    """Map a function fn over the elements of a stream s."""
    if s is Stream.empty:
        return s
    def compute_rest():
        return map_stream(fn, s.rest)
    return Stream(fn(s.first), compute_rest)
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```
>>> s = integer_stream(3)  
>>> s  
Stream(3, <...>)  
>>> m = map_stream(lambda x: x*x, s)  
>>> first_k(m, 5)  
[9, 16, 25, 36, 49]
```

Filtering a Stream

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When filtering a stream, processing continues until an element is kept in the output

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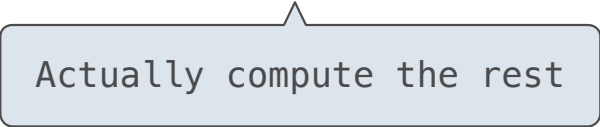
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def filter_stream(fn, s):
    """Filter stream s with predicate function fn."""
    if s is Stream.empty:
        return s
    def compute_rest():
        return filter_stream(fn, s.rest)
    if fn(s.first):
        return Stream(s.first, compute_rest)
    else:
        return compute_rest()
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Actually compute the rest

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