Lambdas, Environments, Midterm Review

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CS8 – Computational Structures in Data Science

http://inst.eecs.berkeley.edu/~cs88

Lecture 6

Oct 1, 2018

Administrative Issues

- Midterm exam: wed Oct 3 6-8 pm
  - Room based on last digit of SID
  - 0-5 LeConte 1   (60%)
  - 6-9: VLSB 2040
  - Alternative and accommodations during 5-9 by request
- Materials will go through 10/1 Lecture
- Please do mid-term survey
- Office hours start here after class and migrate down to BIDS in 190 Doe Library
- Live piazza thread 166

Computational Concepts Toolbox

- Data type: values, literals, operations,
  - e.g., int, float, string
- Expressions, Call expression
- Variables
- Assignment Statement
- Sequences: tuple, list
  - indexing
- Data structures
- Tuple assignment
- Call Expressions
- Function Definition Statement
- Conditional Statement

Environments and Closures

- Iteration:
  - data-driven (list comprehension)
  - control-driven (for statement)
  - while statement
- Higher Order Functions
  - Functions as Values
  - Functions with functions as argument
  - Assignment of function values
- Recursion
- Lambda - function valued expressions

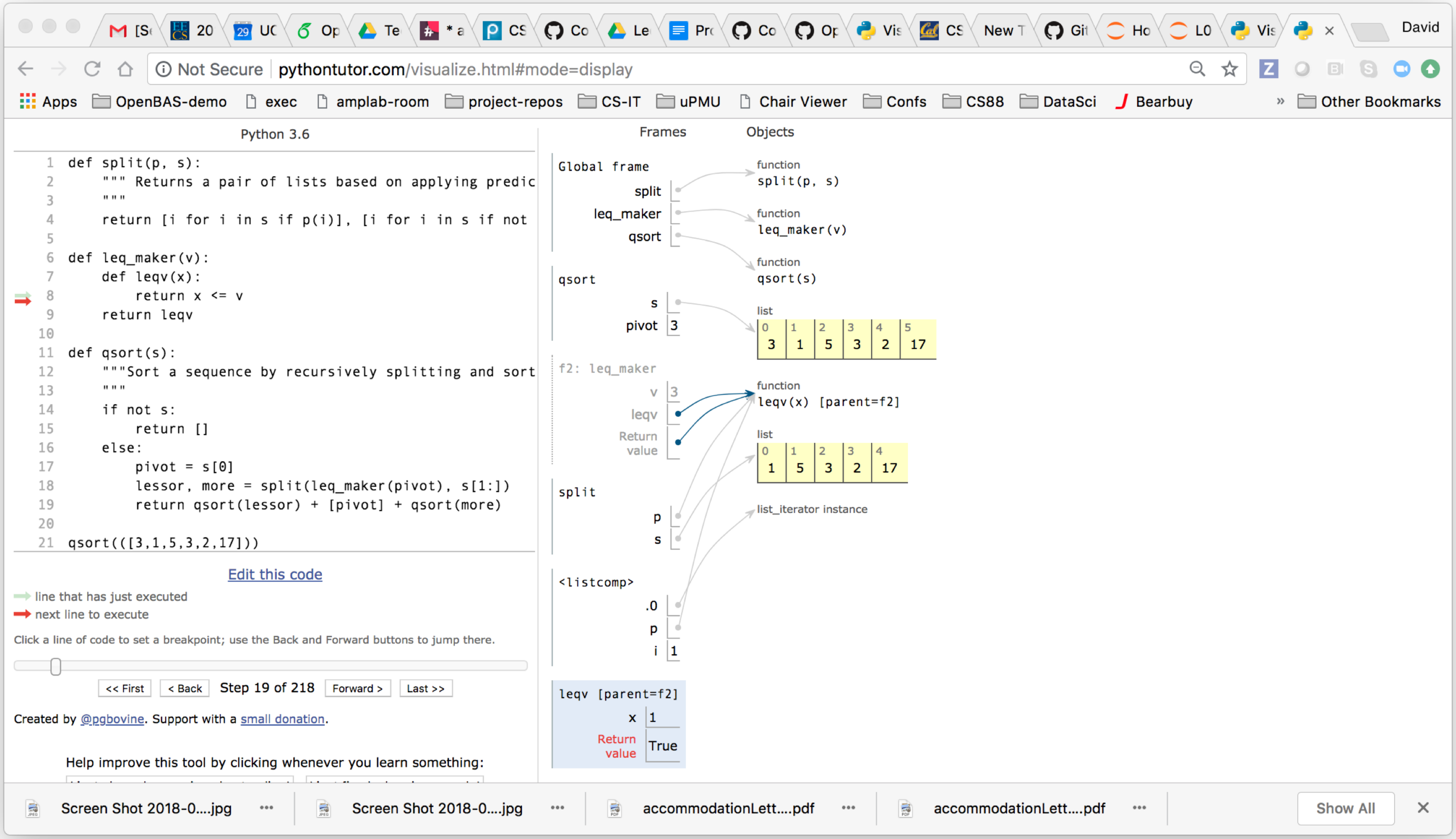
Recall Tree Recursion with HOF

```
def qsort(s):
    """Sort a sequence - split it by the first element,
    sort both parts and put them back together."""

    if not s:
        return []
    else:
        pivot = first(s)
        lessor, more = split_fun(leq_maker(pivot), rest(s))
        return qsort(lessor) + [pivot] + qsort(more)

>>> qsort([3,3,1,4,5,4,3,2,1,17])
[1, 1, 2, 3, 3, 3, 4, 4, 5, 17]
```

Exploring Environments



Python 3.6

```
def split(p, s):
    """ Returns a pair of lists based on applying predic
    """
    return [i for i in s if p(i)], [i for i in s if not

def leq_maker(v):
    def leqv(x):
        return x <= v
    return leqv

def qsort(s):
    """Sort a sequence by recursively splitting and sort
    """
    if not s:
        return []
    else:
        pivot = s[0]
        lessor, more = split(leq_maker(pivot), s[1:])
        return qsort(lessor) + [pivot] + qsort(more)

qsort([3,1,5,3,2,17])
```

Edit this code

line that has just executed
next line to execute

Click a line of code to set a breakpoint; use the Back and Forward buttons to jump there.

<< First | < Back | Step 19 of 218 | Forward > | Last >>

Created by @pgbovine. Support with a small donation.

Help improve this tool by clicking whenever you learn something:

Frames | Objects

```
Global frame                 function
        split                split(p, s)
        leq_maker            function
        qsort                leq_maker(v)
                             function
qsort                        qsort(s)
        s                    list
        pivot 3              0  1  2  3  4  5
                             3  1  5  3  2  17
f2: leq_maker
        v     3              function
        leqv                 leqv(x) [parent=f2]
        Return
        value                list
                             0  1  2  3  4
split                        1  5  3  2  17
        p
        s                    list_iterator instance

<listcomp>
        .0
        p
        i     1

leqv [parent=f2]
        x     1
        Return
        value True
```

lambda

- **Function expression**
  - **“anonymous” function creation**
  - **Expression, not a statement, no return or any other statement**

lambda <arg or arg_tuple> : <expression using args>

```
inc = lambda v : v + 1
```

```
def inc(v):
    return v + 1
```

Lambda Examples

```
>>> sort([1,2,3,4,5], lambda x: x)
    [1, 2, 3, 4, 5]

>>> sort([1,2,3,4,5], lambda x: -x)
    [5, 4, 3, 2, 1]

>>> sort([(2, "hi"), (1, "how"), (5, "goes"), (7, "I")],
          lambda x:x[0])
[(1, 'how'), (2, 'hi'), (5, 'goes'), (7, 'I')]

>>> sort([(2, "hi"), (1, "how"), (5, "goes"), (7, "I")],
         lambda x:x[1])
    [(7, 'I'), (5, 'goes'), (2, 'hi'), (1, 'how')]

>>> sort([(2,"hi"),(1,"how"),(5,"goes"),(7,"I")],
         lambda x: len(x[1]))
    [(7, 'I'), (2, 'hi'), (1, 'how'), (5, 'goes')]
```

http://cs88-website.github.io/assets/slides/adt/mersort.py

Lambdas

```
>>> def inc_maker(i):
...     return lambda x:x+i
...
>>> inc_maker(3)
<function inc_maker.<locals>.<lambda> at 0x10073c510>

>>> inc_maker(3)(4)
7
>>> map(lambda x:x*x, [1,2,3,4])
<map object at 0x1020950b8>

>>> list(map(lambda x:x*x, [1,2,3,4]))
[1, 4, 9, 16]
>>>
```

Thinking back over concepts

- Data type
  - Representation
    - » literals and display
    - » Internal representation
  - Set of operations
  - Conversions to other types
- Expressions – computation of values of a type
  - Built-in operations and function calls
  - Comprehensions
- Statements
  - Assignment & Control
  - Conditionals, Iteration
- Functions – objects and control