Lambdas

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1 Overview

Lambdas are a useful feature in Python and some other languages (notably newer versions of Java). They're helpful in that you can place it wherever you want without explicitly defining a new function. For example, imagine some function that takes in two parameters. One parameter is an integer and the other parameter is a function that operates on that integer.

```
>>> def func(num, f):
...     return f(num)
...
>>>
```

So we've established a very basic function that will return the value of the function f operating on number *num*. We could define a fully fledged function but what if we're just running some basic functions that don't really require a ton of lines to write. Why bother writing a full out function when we can just use a **lambda** statement?

```
>>> func(4, lambda x: x + 1)
5
>>>
```

See how simple and mess free that was? Lambdas as a general rule are just anonymous functions that we can use once and then forget about for the rest of our lives. A word of advice, I'm not a fan of studying material in terms of an exam but it's important to note that in the algorithm portions of midterms and finals in CS61A lambdas are thrown in occasionally to shake things up. If you think you weren't given enough lines for your implementation then think of lambdas. There's a chance that they may be what you need.

2 Understanding the syntax

A lambda function's structure is similar to that of our regular run of the mill python function. Let's compare them.

```
>>> def func(x, y, z):
...     return x + y + z
...
>>> func(1, 2, 3)
6
>>> lambda_func = lambda x, y, z: x + y + z
>>> lambda_fun(1, 2, 3)
6
>>>
```

See how concise lambda functions are? It's important to remember that regardless of how confusing the syntax can be at times, they behave the **exact** same way as regular functions. They can be assigned to variables and they behave the same way on environment diagrams. A key difference between ordinary functions and lambdas is that lambdas **must** have a return value. If you're a little shaky on that concept, read through my notes on return values which should clear up a lot of doubts.

3 What would Python Print: Lambdas

So let's look at some examples of how python expresses lambdas.

```
>>> lam = lambda x, y, z: print(x) print(y) print(z)
  File "<stdin>", line 1
    lambda x, y, z: print(x) print(y) print(z)
                          ^
SyntaxError: invalid syntax
>>> # Remember that lambdas must have a return value and
>>> # that they can only execute one line of code.
>>> lam = lambda x: True
>>> lam(4)
True
>>> lam(False)
True
>>> lam(lambda y: False)
True
>>> # Don't lose track of what the function is doing.
>>> # This function is no different that the following.
>>> def func(x):
...     return True
...
>>> func(False)
True
>>> # This function and the lambda preceding it will
>>> # always return True.
>>> lam2 = lambda x: y
```

```
>>> lam2(5)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
  File "<stdin>", line 1, in <lambda>
NameError: global name 'y' is not defined
>>> # This one should be pretty obvious. We never defined
>>> #  a variable y so there isn't a logical answer
>>> # to this.
>>> # Think about this function.
>>> def func(x):
...     return y
...
>>> # Makes sense?
>>> # Let's try something interesting now.
>>> lam3 = lambda x: if x == 4: True
  File "<stdin>", line 1
    lam3 = lambda x: if x == 1: True
                     ^
SyntaxError: invalid syntax
>>> # Remember that lambdas run the bare minimum
>>> # kind of instruction
>>> # We can also create lambdas that take no parameters
>>> lam = lambda : print("Lambdas are easy!")
>>> lam()
Lambdas are easy!
>>> lam
<function <lambda> at 0x107a17d90>
```

Some major uses for lambda functions are map, filter and reduce.

4 Map, Filter, Reduce

Map is a function that we can use to *map* a function onto a list, for example. We can apply that function to every item in the list we pass in. For reference, the map function takes in the following paramters:

$$map(function, iterable)$$

It will return a map object that we can iterate over.

```
>>> lst = [1,2,3,4,5]
>>> mod_lst = map(lambda x: x + 1, lst)
>>> mod_lst
<map object at 0x107a68358>
>>> for i in mod_lst:
...     i
...
```

```
2
3
4
5
6
>>> for i in mod_lst:
...     i
...
>>>
>>> # Notice that it doesn't print anything the second
>>> # time. We'll get more into this when we talk about
>>> # iterables, iterators, and generators. But keep
>>> # this property in mind in the future.
```

Filter is a function we can use to, as the name implies, *filter* elements out of a list or another type of iterable. The function takes in the following parameters:

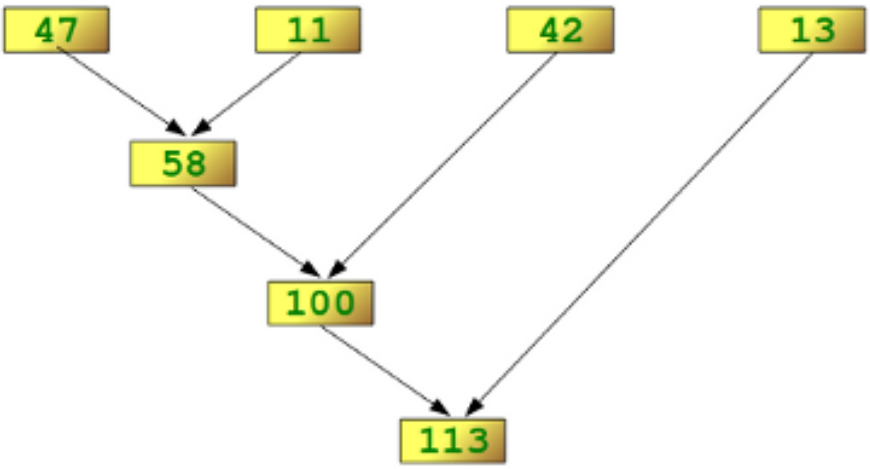
$$filter(function, iterable)$$

The function will return either a true of false value and the new filter object will contain only the values from the original iterable that returned true in the function we pass in.

```
>>> lst = [1,2,3,4,5,6]
>>> f = filter(lambda x: x % 2, lst)
>>> f
<filter object at 0x107a683c8>
>>> for i in f:
...     i
...
1
3
5
>>> for i in f:
...     i
...
>>>
>>>
```

Reduce is a function that we can use to return one value from a sequence. In Python3 there's no built in function for reduce like there is for filter and map so we probably won't use it particularly often. This picture does a good job at explaining it though

```
>>> reduce(lambda x,y: x + y, [47,11,42,13])
113
```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