LECTURE 8

VARIADIC FUNCTIONS AND DECORATORS

MCS 275 Spring 2022

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LECTURE 8: VARIADIC FUNCTIONS AND DECORATORS

Course bulletins:

- Project 1 due Fri 4 Feb at 6:00pm central.
- Project 1 autograder opens on Monday.
- Homework 3 available.

VARIADIC FUNCTIONS

A function is **variadic** if it can accept a variable number of arguments. This is general CS terminology.

Python supports these. The syntax

```
def f(a,b,*args):
```

means that the first argument goes into variable `a`, the second into variable `b`, and any other arguments are put into a tuple which is assigned to `args`

VARIADICS AND KEYWORD ARGUMENTS

The syntax

```
def f(a,b,**kwargs):
```

or

```
def f(a,b,*args,**kwargs):
```

puts extra keyword arguments into a dictionary called `kwargs`.

It is traditional to use the names `args` and `kwargs`, but it is not required.

ARGUMENT UNPACKING

Take arguments from a list or tuple:

```
L = [6,11,16]
f(1,*L) # calls f(1,6,11,16)
```

Take keyword arguments from a dict:

```
d = { "mcs275": "fun", "x": 42 }
f(1,z=0,**d) # calls f(1,z=0,mcs275="fun",x=42)
```

Think of * as "remove the brackets", and ** as "remove the curly braces".

WHY?

Sometimes you may write a function that needs to pass most of its arguments on to another function.

FUNCTION ARGUMENTS

Functions in Python can accept functions as arguments.

```
def dotwice(f):
    """Call function f twice"""
    f()
    f()
```

A better version works with functions that accept arguments:

```
def dotwice(f,*args,**kwargs):
    """Call function f twice (allowing arguments)"""
    f(*args,**kwargs)
    f(*args,**kwargs)
```

RETURNING FUNCTIONS

Functions in Python can return functions. Often this is used with a return value that is a defined inside the function body, making a "function factory".

```
def return_power(n):
    def inner(x): # function inside a function!
        """Raise x to a power"""
        return x**n
    return inner
```

MODIFYING FUNCTIONS

```
def return_twice_doer(f):
    """Return a new function which calls f twice"""
    def inner(*args,**kwargs):
        """Call a certain function twice"""
        f(*args,**kwargs)
        f(*args,**kwargs)
    return inner
```

REPLACING FUNCTIONS

In some cases we might want to replace an existing function with a modified version of it (e.g. as returned by some other function).

```
def g(x):
    """Print the argument with a message"""
    print("Function got value",x)

# actually, I wanted to always print that message twice!
g = return_twice_doer(g)
```

DECORATOR SYNTAX

There is a shorter syntax to replace a function with a modified version.

```
@modifier
def fn(x,y):
    """Function body goes here"""
```

is equivalent to

```
def fn(x,y):
    """Function body goes here"""
fn = modifier(fn)
```

The symbol `@modifier` (or any `@name`) before a function definition is called a **decorator**.

RETURNING VALUES

Usually, the inner function of a decorator should return the value of the (last) call to the argument function.

```
def return_twice_doer(f):
    """Return a new function which calls f twice"""
    def inner(*args,**kwargs):
        """Call a certain function twice"""
        f(*args,**kwargs)
        return f(*args,**kwargs)
    return inner
```

DECORATOR ARGUMENTS

Python allows `@decorator(arg1,arg2,...)`.

```
@dec(2)
def printsq(x):
    print(x*x)
```

is equivalent to

```
thisdec = dec(2)

@thisdec
def printsq(x):
    print(x*x)
```

In other words, if a decorator is given arguments, then the name after `@` is expected to be a **decorator factory**.

A FEW BUILT-IN DECORATORS

- **`@functools.lru_cache(100)`** -- Save arguments and return values for up to 100 recent calls to a function; reuse stored return values when possible. Good for expensive operations.*
- **`@classmethod`** -- Make a method a class method (callable from the class itself, gets class as first argument). E.g. for alternate constructors.
- **`@atexit.register`** -- Ask that this function be called just before the program exits.

* In Python 3.9+ there is also the simpler `functools.cache` decorator which stores an unlimited number of past function calls..

MULTIPLE DECORATORS

Each must be on its own line.

```
@dec1
@dec2
@dec3
def f(x):
    """Function body goes here"""
```

replaces `f` with `dec1(dec2(dec3(f)))`.

So the decorator closest to the function name acts first.

REFERENCES

- See Lutz, Chapter 18 for more about function arguments (including variadic functions).
- Beazley & Jones, Chapter 7 has examples of variadic functions.
- See Lutz, Chapter 39 for a detailed discussion of Python decorators.
- See Beazley & Jones, Chapter 9 for several examples of decorators.

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REVISION HISTORY

- 2022-01-26 Initial publication