

61A Lecture 8

Announcements

Abstraction

Functional Abstractions

```
def square(x):          def sum_squares(x, y):
    return mul(x, x)    return square(x) + square(y)
```

What does sum_squares need to know about square?

- Square takes one argument. Yes
- Square has the intrinsic name square. No
- Square computes the square of a number. Yes
- Square computes the square by calling mul. No

```
def square(x):          def square(x):
    return pow(x, 2)    return mul(x, x-1) + x
```

If the name "square" were bound to a built-in function, sum_squares would still work identically.

Choosing Names

Names typically don't matter for correctness
but
they matter a lot for composition

From:	To:
true_false	rolled_a_one
d	dice
helper	take_turn
my_int	num_rolls
l, I, 0	k, i, m

Names should convey the meaning or purpose of the values to which they are bound.

The type of value bound to the name is best documented in a function's docstring.

Function names typically convey their effect (**print**), their behavior (**triple**), or the value returned (**abs**).

Which Values Deserve a Name

Reasons to add a new name

Repeated compound expressions:

```
if sqrt(square(a) + square(b)) > 1:
    x = x + sqrt(square(a) + square(b))
```

```
hypotenuse = sqrt(square(a) + square(b))
if hypotenuse > 1:
    x = x + hypotenuse
```

Meaningful parts of complex expressions:

```
x = (-b + sqrt(square(b) - 4 * a * c)) / (2 * a)
```

```
discriminant = sqrt(square(b) - 4 * a * c)
x = (-b + discriminant) / (2 * a)
```

More Naming Tips

• Names can be long if they help document your code:
average_age = average(age, students)

is preferable to
Compute average age of students
aa = avg(a, st)

• Names can be short if they represent generic quantities: counts, arbitrary functions, arguments to mathematical operations, etc.

n, k, i - Usually integers
x, y, z - Usually real numbers
f, g, h - Usually functions

PRACTICAL GUIDELINES

Testing

Test-Driven Development

Write the test of a function before you write the function.

A test will clarify the domain, range, & behavior of a function.

Tests can help identify tricky edge cases.

Develop incrementally and test each piece before moving on.

You can't depend upon code that hasn't been tested.

Run your old tests again after you make new changes.

Bonus idea: Run your code interactively.

Don't be afraid to experiment with a function after you write it.

Interactive sessions can become doctests. Just copy and paste.

(Demo)

Currying

Function Currying

```
def make_adder(n):
    return lambda k: n + k
```

```
>>> make_adder(2)(3)
5
>>> add(2, 3)
5
```

There's a general relationship between these functions

(Demo)

Curry: Transform a multi-argument function into a single-argument, higher-order function

Decorators

Function Decorators

(Demo)

Function decorator

```
@trace1
def triple(x):
    return 3 * x
```

Decorated function

is identical to

Why not just use this?

```
def triple(x):
    return 3 * x
triple = trace1(triple)
```

Review

What Would Python Print?

The print function returns None. It also displays its arguments (separated by spaces) when it is called.

	This expression	Evaluates to	Interactive Output
	5	5	5
	print(5)	None	5
	print(print(5))	None	5 None
	def delay(arg): print('delayed') def g(): return arg return g		
	delay(delay)()(6)()	6	delayed delayed 6
	print(delay(print)()(4))	None	delayed 4 None

```
def horse(mask):
    horse = mask
    def mask(horse):
        return horse
    return horse(mask)
mask = lambda horse: horse(2)
horse(mask)
```

