

61A Lecture 9

Friday, September 19

Announcements

- Midterm 1 is on Monday 9/22 from 7pm to 9pm
- 2 review sessions on Saturday 9/20 3pm-4:30pm and 4:30pm-6pm in 1 Pimentel
- HKN review session on Sunday 9/21 from 12pm to 3pm in 2060 Valley LSB
- No lecture on Monday
- No lab or office hours next week: Tuesday 9/23, or Wednesday 9/24
- Optional Hog strategy contest ends Wednesday 10/1 @ 11:59pm

Abstraction

Functional Abstractions

```
def square(x):
    return mul(x, x)

def sum_squares(x, y):
    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):
    return pow(x, 2)

def square(x):
    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: |
|--------------------------|---------------------------|
| <code>true_false</code> | <code>rolled_a_one</code> |
| <code>d</code> | <code>dice</code> |
| <code>play_helper</code> | <code>take_turn</code> |
| <code>my_int</code> | <code>num_rolls</code> |
| <code>l, I, 0</code> | <code>k, i, m</code> |

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.

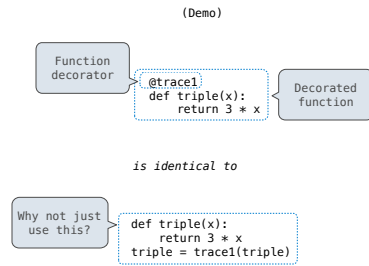
Don't be afraid to experiment with a function after you write it.

Interactive sessions can become doctests. Just copy and paste.

(Demo)

Decorators

Function Decorators



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 |

A function that takes any argument and returns a function that returns that arg

Names in nested def statements can refer to their enclosing scope

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 |
|---|--------------|-------------------------|
| from operator import add, mul def square(x): return mul(x, x) | | |
| add(pirate(3)(square)(4), 1) | 17 | Matey 17 |
| def pirate(arggg): print("matey") def plunder(arggg): return arggg return plunder | | |
| pirate(pirate(pirate))(5)(7) | Error | Matey Matey Error |

A function that always returns the identity function

Identity function

A name evaluates to the value bound to that name in the earliest frame of the current environment in which that name is found.

