Function Examples

Announcements

Hog Contest Rules

- Up to two people submit one entry; Max of one entry per person
- Slight rule changes
- Your score is the number of entries against which you win more than 50.00001% of the time
- Strategies are time-limited
- All strategies must be deterministic, pure functions of the players' scores
- All winning entries will receive extra credit
- The real prize: honor and glory
- See website for detailed rules

Fall 2011 Winners

Kaylee Mann
Yan Duan & Ziming Li
Brian Prike & Zhenghao Qian
Parker Schuh & Robert Chatham

Fall 2012 Winners

Chenyang Yuan
Joseph Hui

Fall 2013 Winners

Paul Bramsen
Sam Kumar & Kangsik Lee
Kevin Chen

Fall 2014 Winners

Alan Tong & Elaine Zhao
Zhenyang Zhang
Adam Robert Villaflor & Joany Gao
Zhen Qin & Dian Chen
Zizheng Tai & Yihe Li

cs61a.org/proj/hog_contest

Hog Contest Winners

Spring 2015 Winners

Sinho Chewi & Alexander Nguyen Tran
Zhaoxi Li
Stella Tao and Yao Ge

Fall 2015 Winners

Micah Carroll & Vasilis Oikonomou
Matthew Wu
Anthony Yeung and Alexander Dai

Spring 2016 Winners

Michael McDonald and Tianrui Chen
Andrei Kassiantchouk
Benjamin Krieges

Your name could be here FOREVER!

Spring 2017 Winners

Cindy Jin and Sunjoon Lee
Anny Patino and Christian Vasquez
Asana Choudhury and Jenna Wen
Michelle Lee and Nicholas Chew

Fall 2017 Winners

Alex Yu and Tanmay Khattar
James Li
Justin Yokota

Spring 2018 Winners

Eric James Michaud
Ziyu Dong
Xuhui Zhou

Fall 2018 Winners

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, O	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
```

PRACTICAL GUIDELINES

Meaningful parts of complex expressions:

```
x1 = (-b + sqrt(square(b) - 4 * a * c)) / (2 * a)
```

```
discriminant = square(b) - 4 * a * c
x1 = (-b + sqrt(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
```

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 Display?

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

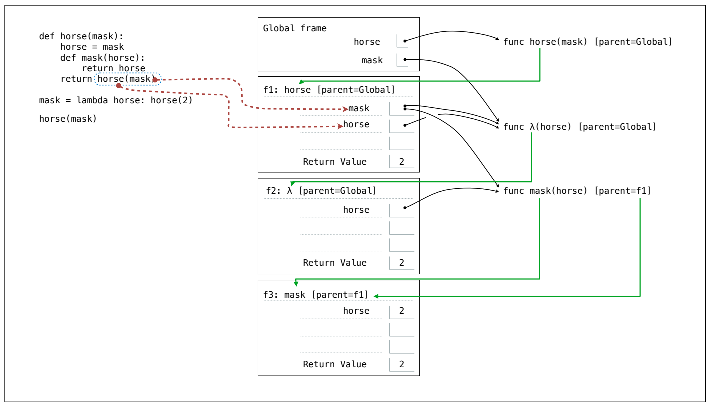
```
from operator import add, mul
def square(x):
    return mul(x, x)
```

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

```
def delay(arg):
    print('delayed')
    def g():
        return arg
    return g
```

Names in nested def statements can refer to their enclosing scope

This expression	Evaluates to	Interactive Output
5	5	5
print(5)	None	5
print(print(5)) None	None	5 None
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)
```