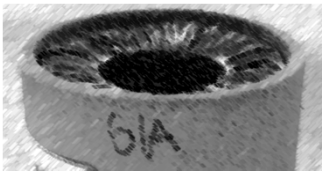


# CS61A Lecture 3

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## Announcements

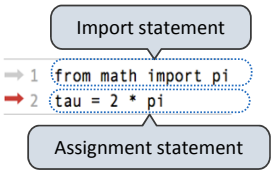
- Reminder: hw0 due tonight, hw1 due Wed.
- In-class quiz on Friday
  - Covers through Wednesday's lecture
  - Bring a writing implement
- Hog project out
  - Get started early!
  - More on hog next time

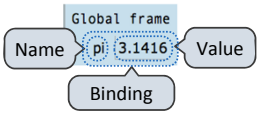
## The Elements of Programming

- Primitive Expressions and Statements
  - The simplest building blocks of a language
- Means of Combination
  - Compound elements built from simpler ones
- Means of Abstraction
  - Elements can be named and manipulated as units

## Environment Diagrams

Environment diagrams visualize the interpreter's process.




Code (left):

Statements and expressions

Next line is highlighted

Frames (right):

A name is bound to a value

In a frame, there is at most one binding per name

Example: http://goo.gl/SK13i

## User-Defined Functions

Named values are a simple means of abstraction

Named computational processes are a more powerful means of abstraction

Function "signature" indicates how many parameters

```
>>> def <name>(<formal parameters>):
        return <return expression>
```

Function "body" defines a computational process

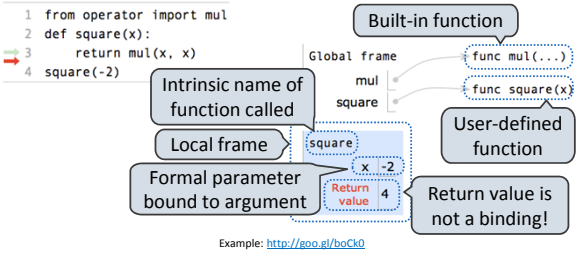
Execution procedure for def statements:

1. Create a function value with signature <name>(<formal parameters>)
2. Bind <name> to that value in the current frame

## Calling User-Defined Functions

Procedure for applying user-defined functions (version 1):

1. Add a local frame
2. Bind formal parameters to arguments in that frame
3. Execute the body of the function in the new environment



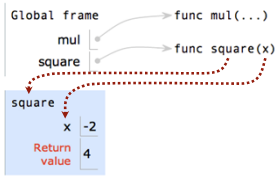

Example: http://goo.gl/boCk0

## Calling User-Defined Functions

Procedure for applying user-defined functions (version 1):

1. Add a local frame
2. Bind formal parameters to arguments in that frame
3. Execute the body of the function in the new environment

```
1 from operator import mul
2 def square(x):
3     return mul(x, x)
4 square(-2)
```



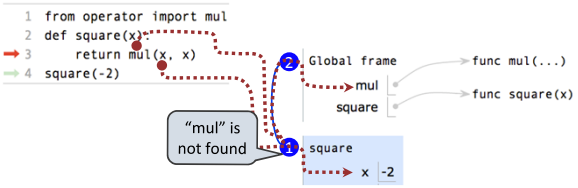

A function's signature has all the information to create a local frame

Example: http://goo.gl/boCk0

## Looking Up Names

Procedure for looking up a name from inside a function (v. 1):

1. Look it up in the local frame
2. If not in local frame, look it up in the global frame
3. If in neither frame, generate error




Example: http://goo.gl/boCk0

## General Lookup Procedure

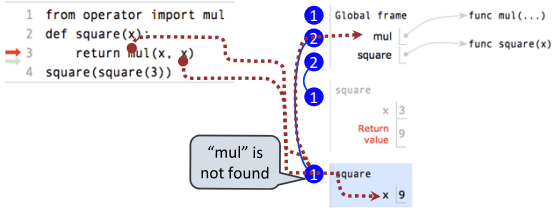
- Every expression is evaluated in the context of an environment
- So far, the current environment is either:
  - The global frame alone, or
  - A local frame, followed by the global frame
- **Important properties of environments:**
  - An environment is a sequence of frames
  - The earliest frame that contains a binding for a name determines the value that the name evaluates to
- The *scope* of a name is the region of code that has access to it

## Multiple Environments in a Diagram

Every expression is evaluated in the context of an environment.

The earliest frame that contains a binding for a name determines the value that the name evaluates to.

mul(x, x)




Example: http://goo.gl/hrfnV

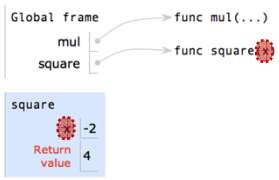
## Formal Parameters

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

vs

def square(y):
  return mul(y, y)

```
1 from operator import mul
2 def square(x):
3     return mul(x, x)
4 square(-2)
```




Formal parameters have local scope

Example: http://goo.gl/boCk0

## Life Cycle of a User-Defined Function