

We Write Programs to Do Things

- Functions are the **key doers**

Function Call

- Command to **do** the function

```
>>> plus(23)
24
>>>
```

Function Header

Function Definition

- Defines what function **does**

```
def plus(n):
    return n+1
```

Function Body (indented)

- Parameter:** variable that is listed within the parentheses of a method header.
- Argument:** a value to assign to the method parameter when it is called

Anatomy of a Function Definition

```
def plus(n):
    """Returns the number n+1
    Parameter n: number to add to
    Precondition: n is a number"""
    x = n+1
    return x
```

name parameters

Function Header

Docstring Specification

Statements to execute when called

The vertical line indicates indentation

Use vertical lines when you write Python on exams so we can see indentation

The return Statement

- Format:** return <expression>
 - Used to evaluate *function call* (as an expression)
 - Also stops executing the function!
 - Any statements after a **return** are ignored
- Example:** temperature converter function

```
def to_centrigrade(x):
    """Returns: x converted to centigrade"""
    return 5*(x-32)/9.0
```

A More Complex Example

Function Definition

```
def foo(a,b):
    """Return something
    Param a: number
    Param b: number"""
    x = a
    y = b
    return x*y+y
```

Function Call

```
>>> x = 2
>>> foo(3,4)
```

x ?

What is in the box?

A: 2
B: 3
C: 16
D: Nothing!
E: I do not know

Understanding How Functions Work

- Function Frame:** Representation of function call
- A **conceptual model** of Python

Draw parameters as variables (named boxes)

- Number of statement in the function body to execute next
- Starts with 1

function name

parameters

local variables (later in lecture)

instruction counter

Text (Section 3.10) vs. Class

Textbook

to_centrigrade

x -> 50.0

This Class

to_centrigrade

1

x 50.0

Definition:

```
def to_centrigrade(x):
    return 5*(x-32)/9.0
```

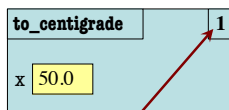
Call: to_centrigrade(50.0)

Example: to_centigrade(50.0)

1. Draw a frame for the call
2. Assign the argument value to the parameter (in frame)
3. Execute the function body
 - Look for variables in the frame
 - If not there, look for global variables with that name
4. Erase the frame for the call

```
def to_centigrade(x):
1 | return 5*(x-32)/9.0
```

Initial call frame
(before exec body)



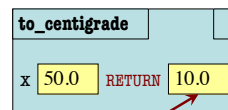
next line to execute

Example: to_centigrade(50.0)

1. Draw a frame for the call
2. Assign the argument value to the parameter (in frame)
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```
def to_centigrade(x):
1 | return 5*(x-32)/9.0
```

Executing the
return statement



Return statement creates a
special variable for result

Call Frames vs. Global Variables

The specification is a **lie**:

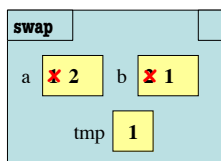
```
def swap(a,b):
    """Swap global a & b"""
1 | tmp = a
2 | a = b
3 | b = tmp

>>> a = 1
>>> b = 2
>>> swap(a,b)
```

Global Variables



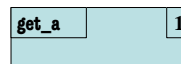
Call Frame



Function Access to Global Space

- All function definitions are in some module
- Call can access global space for **that module**
 - math.cos: global for math
 - temperature.to_centigrade uses global for temperature
- But **cannot** change values
 - Assignment to a global makes a new local variable!
 - Why we limit to constants

Global Space
(for globals.py) a 4



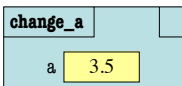
```
# globals.py
"""Show how globals work"""
a = 4 # global space

def get_a():
    return a # returns global
```

Function Access to Global Space

- All function definitions are in some module
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- But **cannot** change values
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Global Space
(for globals.py) a 4



```
# globals.py
"""Show how globals work"""
a = 4 # global space
def change_a():
    a = 3.5 # local variable
    return a
```

Exercise Time

Function Definition

Function Call

```
def foo(a,b):
    """Return something
    Param x: a number
    Param y: a number"""
1 | x = a
2 | y = b
3 | return x*y+y
```

```
>>> x = foo(3,4)
```

What does the
frame look like
at the **start**?