UC Berkeley EECS
Lecturer
Michael Ball

# Computational Structures in Data Science

# Lecture 3:
# Functions and Lops

# Announcements

- In person next week!
- Please check the CS88 Google Calendar for locations

# Let's Talk About Python

- Expression `3.1 * 2.6`
- Call expression `max(0, x)`
- Variables
- Assignment Statement `x = <expression>`
- Define Function: `def <function name> (<parameter list>):`
- Control Statements: `if …`
  `while …`

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# Python: Definitions and Control

# Learning Objectives

- Create your own functions.
- Write a loop to run the same code multiple times
- Use conditionals to control when a loop stops

# Conditional Statement

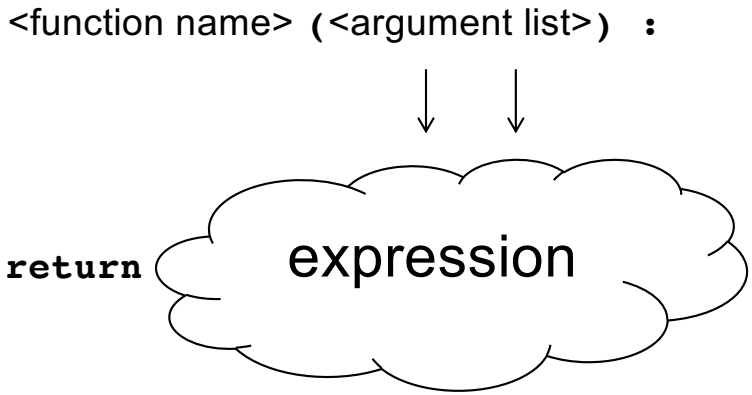
- Do some statements, conditional on a *predicate* expression

```
if <predicate>:
        <true statements>
else:
        <false statements>
```

- Example:

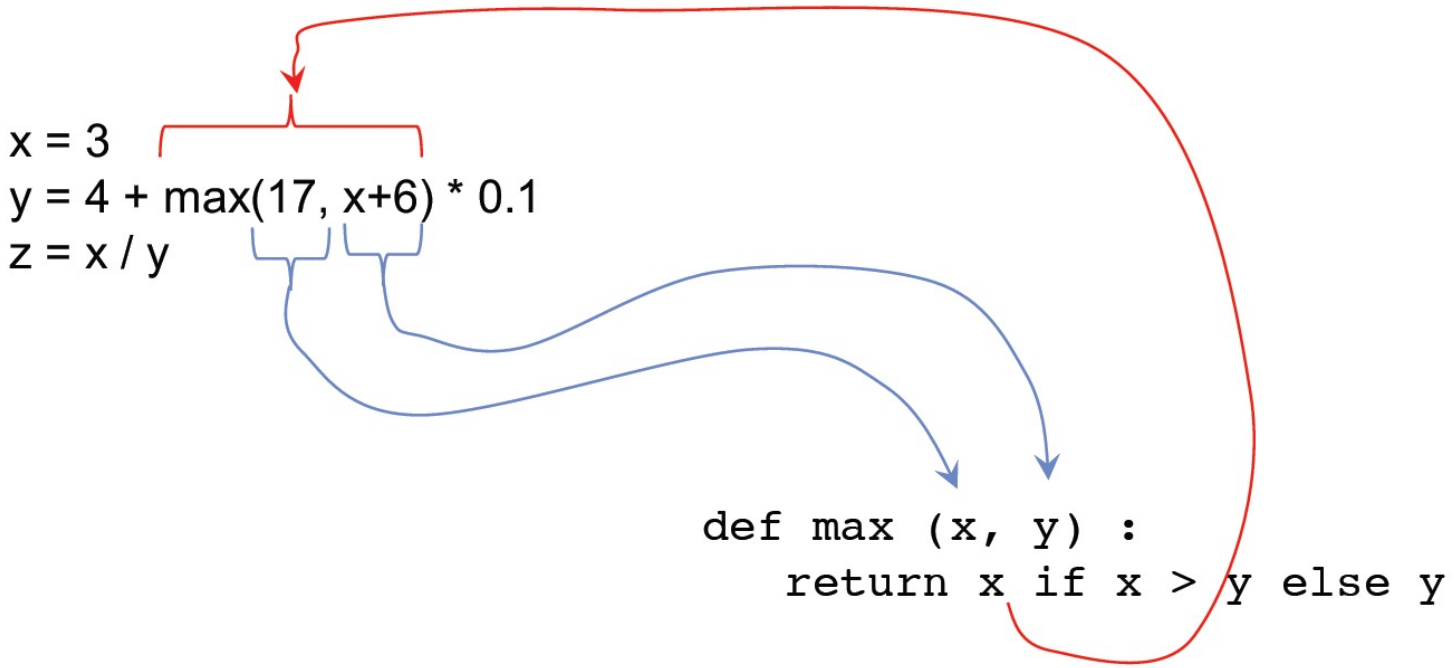
```
if (temperature>37.2):
        print("fever!")
else:
        print("no fever")
```

# Defining Functions




- Abstracts an expression or set of statements to apply to lots of instances of the problem
- A function should *do one thing well*

# Functions: Example



# How to Write a Good Function

- Give a descriptive name
  - Function names should be lowercase. If necessary, separate words by underscores to improve readability. Names are extremely suggestive!
- Chose meaningful parameter names
  - Again, names are extremely suggestive.

- Write the docstring to explain *what* it does
  - What does the function return? What are corner cases for parameters?

Python Style Guide: https://www.python.org/dev/peps/pep-0008

- Write doctest to show what it should do
  - Before you write the implementation.

# Functions: Calling and Returning Results

Python Tutor

```
def max(x, y):
    return x if x > y else y

x = 3
y = 4 + max(17, x + 6) * 0.1
z = x / y
```

# Doctests

- Write the docstring to explain *what* it does
  - What does the function return? What are corner cases for parameters?

- Write doctest to show what it should do
  - Before you write the implementation.
  - python3 –m doctest [-v] file.py

# Returns and Values

- All functions always return SOME value.
- If you don't specify `return`, the value is `None`.

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## Iteration with `while` Loops

# Learning Objectives

- Use a while loop to repeat some task.
- Write an expression to control when a while loop stops executing

# `while` Statement – Iteration Control

- Repeat a block of statements until a predicate expression is satisfied

```
<initialization statements>
while <predicate expression>:
    <body statements>

<rest of the program>
```

# Sum The Numbers

- This is a task we'll see many times!

```
total = 0
n = 1
while n <= 10:
    total += n
    n += 1
print(total)
```

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# Computational Structures in Data Science

# Environments & Higher Order Functions

# Learning Objectives

- **Use environment diagrams to model Python**

# Environment Diagrams

- Organizational tools that help you understand code
- **Terminology:**
  - **Frame:** keeps track of variable-to-value bindings, each function call has a frame
  - **Global Frame:** global for short, the starting frame of all python programs, doesn't correspond to a specific function
  - **Parent Frame:** The frame of where a function is defined (default parent frame is global)
  - **Frame number:** What we use to keep track of frames, f1, f2, f3, etc
  - **Variable** vs **Value**: x = 1. x is the **variable (name)**, 1 is the **value**

# Environment Diagrams Steps

1. Draw the global frame
2. When evaluating assignments (lines with single equal), always evaluate right side first
3. When you **call** a function MAKE A NEW FRAME!
4. When assigning a primitive expression (number, boolean, string) write the value in the box
5. When assigning anything else, draw an arrow to the value
6. When calling a function, name the frame with the intrinsic name – the name of the function that variable points to
7. The parent frame of a function is the frame in which it was defined in (default parent frame is global)
8. If the variable isn't in the current frame, search in the parent frame

# Environment Diagram Tips / Links

- NEVER EVER draw an arrow from one variable to another.
- Useful Resources:
  - http://markmiyashita.com/cs61a/environment_diagrams/rules_of_environment_diagrams/
  - http://albertwu.org/cs61a/notes/environments.html

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## Iteration With `for` Loops

# Learning Objectives

- Compare a `for` loop and a `while` loop.
- Learn to use `range()`
- Use a string as a sequence of letters

# `for` Statement – Iteration Control

- Repeat a block of statements for a structured sequence of variable bindings

```
<initialization statements>
for <variables> in <sequence expression>:
  <body statements>

<rest of the program>
```

# `<sequence expression>` — What's that?

- Sequences are a *type* of data that can broken down into smaller parts.
- Common sequences:
  - range() – gimme all the numbers
  - strings
  - lists (next week!)
- We'll start with two basic facts:
  - range(10) is the numbers 0 to 9, or range(0, 10)
  - `[]` means "indexing" an item in a sequence.
  - `"Hello"[0] == "H"`

# Data-Driven Iteration

- describe an expression to perform on each item in a sequence
- let the data dictate the control

```
[ <expr with loop var> for <loop var> in <sequence expr > ]
```