Lecture 3: Control

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Announcements

- Do HW0! Due today (Wednesday, 6/22) at 11:59pm
- First quiz is tomorrow at the beginning of lecture (yes, this class moves fast…)
  - How should I prepare? Read this Piazza post
- Go to lab today! Each lab is worth two points
- Go to discussion tomorrow! Each discussion is worth two *exam recovery points*
  - If you do poorly (< 20 points) on the midterm or final, exam recovery points can help you make up a portion of the lost points, up to a score of 19.5
  - Details on cs61a.org/articles/about.html#discussion-participation
- Ask questions during lecture on Piazza! Read this post

Functions Review

- The operands of a call expression can be any expression

- This includes expressions that evaluate to functions, such as function names!

Interactive Diagram

Roadmap

Introduction

Functions

Data

Mutability

Objects

Interpretation

Paradigms

Applications

- This week (Introduction), the goals are:
  - To learn the fundamentals of programming
  - To become comfortable with Python

Control

- So far, our programs have included:
  - Expressions (call expressions in particular)
  - Assignment and def statements

- But this is not enough to (easily) write most useful programs

- For example, how would you write a function that:
  - Returns the absolute value of a number?
  - Returns the factorial of a number?

- These functions are easy to write if we introduce *control*
  - Special expressions and statements can *control* how the program is executed by the interpreter

Conditionals

if statements and Boolean operators

Conditional statements (demo)

```
def absolute_value(x):
    """Return the absolute value of x."""
    if x < 0:
        return -x
    else:
        return x
```

Syntax:

- Always starts with **if** clause.
- Zero or more **elif** clauses.
- Zero or one **else** clause, always at the end.

Execution Rule for Conditional Statements:

Each header is considered in order.

1. Evaluate the header's expression, if the header is not an **else**.
2. If the expression is a true value or the header is an **else**, execute the suite & skip the remaining headers.

Boolean contexts

George Boole

```
def absolute_value(x):
    """Return the absolute value of x."""
    if x < 0:
        return -x
    else:
        return x
```

Boolean context

Execution Rule for Conditional Statements:

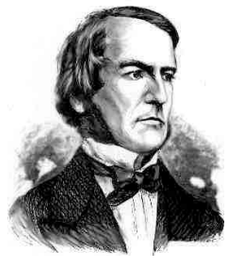
Each header is considered in order.

1. Evaluate the header's expression, if the header is not an **else**.
2. If the expression is a true value or the header is an **else**, execute the suite & skip the remaining headers.

False values in Python: `False`, `None`, `0`, `0.0`, `''`, `[]` *(more to come)*

True values in Python: Everything else

Boolean expressions



(demo)

- Expressions that contain special operators **and**, **or**, **not**

- **not** <exp> evaluates to True if <exp> is a false value,
  False if <exp> is a true value

- Special *short-circuiting behavior*:
  - <left> **and** <right> does not evaluate <right> if <left> evaluates to a false value
  - <left> **or** <right> does not evaluate <right> if <left> evaluates to a true value

- 0 **and** 1/0 evaluates to 0, 0 **or** 1/0 gives an error

Iteration

while loops, Sequences, and **for** loops

`while` loops (demo)

```
def factorial(n):
    """Return the factorial of n."""
    i, total = 1, 1
    while i < n:
        i += 1
        total *= i
    return total
```

Execution Rule for `while` Statements:

1. Evaluate the header's expression.
2. If it is a true value, execute the suite, then return to step 1.

Sequences and `for` loops (demo)

```
def factorial(n):
    """Return the factorial of n."""
    total = 1
    for i in range(1, n+1):
        total *= i
    return total
```

Execution Rule for `for` Statements:

1. Evaluate the sequence in the header's expression.
2. For each value in the sequence, in order:
    1. Bind the name in the header's expression to that value.
    2. Execute the suite.

Summary (demo)

- *Control* allows the interpreter to selectively or repeatedly execute parts of our program

- *Conditionals* allows for different behavior based on the input to and state of the program
  - Using this, we wrote an absolute value function

- *Iteration* allows for parts of our program to be repeatedly executed a specific number of times
  - Using this, we wrote a factorial function

- Putting it all together: let’s look at one more example