

## Lecture 3: Control

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## Announcements

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- 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](https://cs61a.org/articles/about.html#discussion-participation)
- Ask questions during lecture on Piazza! [Read this post](#)

## Functions Review

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- The operands of a call expression can be any expression
- This includes expressions that evaluate to functions, such as function names!

[Interactive Diagram](#)

## Roadmap

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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

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- 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

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**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
```

### 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

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(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