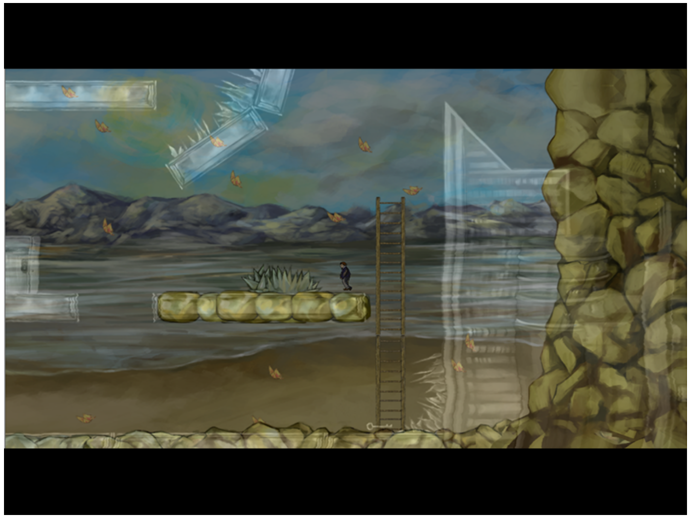
Lecture 1

Course Overview, Python Basics

We Are Very Full!

- Lectures and Labs are at fire-code capacity
  - We cannot add sections or seats to lectures
  - You may have to wait until someone drops
- **No auditors** are allowed this semester
  - All students must do assignments
  - Graduate students should take CS 1133
- CS 1112 has plenty of room for students

About Your Instructor: Walker White



- **Director**: GDIAC
  - **G**ame **D**esign **I**nitiative **at** **C**ornell
  - Teach game design
- (and CS 1110 in fall)

CS 1110 Fall 2015

- **Outcomes:**
  - **Fluency** in (Python) procedural programming
    - Usage of assignments, conditionals, and loops
    - Ability to create Python modules and programs
  - **Competency** in object-oriented programming
    - Ability to recognize and use objects and classes
  - **Knowledge** of searching and sorting algorithms
    - Knowledge of basics of vector computation
- **Website:**
  - www.cs.cornell.edu/courses/cs1110/2016fa/

Intro Programming Classes Compared

CS 1110: Python

- No prior programming experience necessary
- **No calculus**
- *Slight* focus on
  - **Software engineering**
  - **Application design**

CS 1112: Matlab

- No prior programming experience necessary
- **One semester of calculus**
- *Slight* focus on
  - **Scientific computation**
  - **Engineering applications**

But either course serves as a pre-requisite to CS 2110

CS 1133: Short Course in Python

- Catalogue lists as "Transition to Python"
  - Says it requires programming experience
  - **This is a lie**
- 1-credit course in how to use Python
  - All the Python of 1110 without the theory
  - Three assignments; no exams
  - No experience required
- For graduate students who need Python

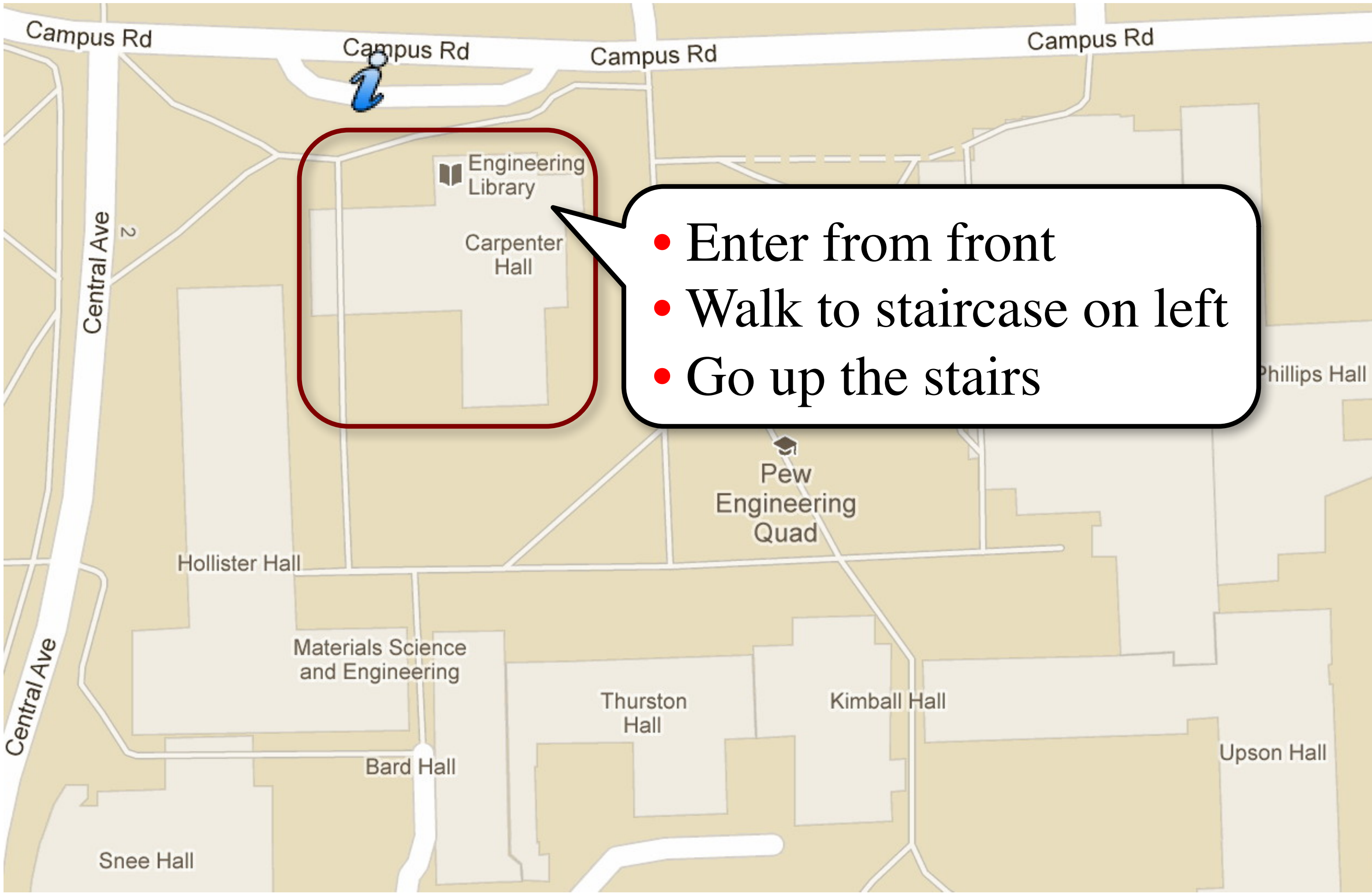
Why Programming in Python?

- Python is **easier for beginners**
  - A lot less to learn before you start “doing”
  - Designed with “rapid prototyping” in mind
- Python is **more relevant to non-CS majors**
  - NumPy and SciPy heavily used by scientists
- Python is a more **modern language**
  - Popular for web applications (e.g. Facebook apps)
  - Also applicable to mobile app development

Class Structure

- **Lectures.** Every Tuesday/Thursday
  - Not just slides; interactive demos almost every lecture
  - Because of enrollment, please stay with your section
  - **Semi-Mandatory**. 1% Participation grade from iClickers
- **Section/labs.** ACCEL Lab, Carpenter 2nd floor
  - The "overflow sections" are in **Phillips 318**
  - Guided exercises with TAs and consultants helping out
    - Tuesday: 12:20, 1:25, 2:30, 3:35
    - Wednesday: 10:10, 11:15, 12:20, 1:25, 2:30, 3:35, 7:20
  - Contact Amy (ahf42@cornell.edu) for section conflicts
  - **Mandatory**. Missing more than 2 lowers your final grade

ACCEL Labs



- Enter from front
- Walk to staircase on left
- Go up the stairs

Class Materials

- **Textbook.** *Think Python* by Allen Downey
  - *Supplemental* text; does not replace lecture
  - Book available for free as PDF or eBook
  - Hardbound copies only available online
- **iClicker.** Acquire one by **next Thursday**
  - Will periodically ask questions during lecture
  - Will get credit for answering – even if wrong
  - iClicker App for smartphone **is not** acceptable
- **Python.** Necessary if you want to use own computer
  - See course website for how to install the software

This Class is OS Agnostic

The Preferred OSes

Do NOT Even THINK It!

Do NOT Even THINK It!

Things to Do Before Next Class

1. Register your iClicker
   - Does not count for grade if not registered
2. Enroll in Piazza
3. Sign into CMS
   - Complete the Quiz
   - Complete Survey 0
4. Read the textbook
   - Chapter 1 (browse)
   - Chapter 2 (in detail)

- Everything is on website!
  - Piazza instructions
  - Class announcements
  - Consultant calendar
  - Reading schedule
  - Lecture slides
  - Exam dates
- Check it regularly:
  - www.cs.cornell.edu/courses/cs1110/2016fa/

Academic Integrity

- Every semester we have cases of *plagiarism*
  - Claiming the work of others as your own
  - This is an **Academic Integrity violation**
- Protect yourself by **citing your sources**
  - Just like in writing a paper for freshman seminar
  - Course website covers how and when to cite
- Complete Academic Integrity Quiz on CMS
  - Must complete successfully to stay in class

A Word About About Grades

- As Cornell students, we know that you care
- But this is **not** a weed-out course
  - Students can do well regardless of experience
- But you may have to work hard!
  - If no experience, budget 10 hours of homework a week

	A	B	C	D/F
All Students	**33%**	**45%**	**20%**	**2%**
AP Students	50%	40%	10%	0%
Some Experience	45%	35%	20%	0%
No Experience	25%	50%	22%	3%

Getting Started with Python

- Designed to be used from the "command line"
  - OS X/Linux: **Terminal**
  - Windows: **Command Prompt**
  - Purpose of the first lab
- Once installed type "python"
  - Starts an *interactive shell*
  - Type commands at >>>
  - Shell responds to commands
- Can use it like a calculator
  - Use to evaluate *expressions*

This class uses Python 2.7.x
- Python 3 has many "issues"
- May be incompatible

The Basics

Values

- 42
- 12.345
- "Hello!"

Types

- **int**eger
- **float** (real number)
- **str**ing (of characters)

Expressions

- 34 * (23 + 14)
- 1.0 / 3.0
- "Hel" + "lo!"

Python and Expressions

- An expression **represents** something
  - Python *evaluates it* (turns it into a value)
  - Similar to what a calculator does
- Examples:
  - `2.3`

    Literal (evaluates to self)

  - `(3 * 7 + 2) * 0.1`

    An expression with four literals and some operators

Representing Values

- **Everything** on a computer reduces to numbers
  - Letters represented by numbers (ASCII codes)
  - Pixel colors are three numbers (red, blue, green)
  - So how can Python tell all these numbers apart?

Memorize this definition!

- **Type:**
  A set of values and the operations on them.
  - Examples of operations: +, -, /, *
  - The meaning of these depends on the type

Example: Type int

- Type **int** represents integers
  - values: …, –3, –2, –1, 0, 1, 2, 3, 4, 5, …
    - Integer literals look like this: 1, 45, 43028030 (no commas or periods)
  - operations: +, –, *, /, **, unary –

    (multiply) (to power of)
- **Principle**: operations on **int** values must yield an **int**
  - **Example:** 1 / 2 rounds result down to 0
    - Companion operation: % (remainder)
    - 7 % 3 evaluates to 1, remainder when dividing 7 by 3
  - Operator / is not an **int** operation in Python 3 (use // instead)

Example: Type float

- Type **float** (floating point) represents real numbers
  - values: distinguished from integers by decimal points
    - In Python a number with a "." is a **float** literal (e.g. `2.0`)
    - Without a decimal a number is an **int** literal (e.g. `2`)
  - operations: `+`, `–`, `*`, `/`, `**`, unary `–`
    - The meaning for floats differs from that for ints
    - **Example**: `1.0/2.0` evaluates to `0.5`
- **Exponent notation** is useful for large (or small) values
  - `–22.51e6` is $-22.51 * 10^{6}$ or -22510000
  - `22.51e-6` is $22.51 * 10^{-6}$ or 0.00002251

A second kind of **float** literal

Floats Have Finite Precision

- Python stores floats as **binary fractions**
  - Integer mantissa times a power of 2
  - Example: 1.25 is $5 * 2^{-2}$

    mantissa **exponent**

- Impossible to write most real numbers this way exactly
  - Similar to problem of writing 1/3 with decimals
  - Python chooses the closest binary fraction it can
- This approximation results in **representation error**
  - When combined in expressions, the error can get worse
  - **Example**: type `0.1 + 0.2` at the prompt >>>

Example: Type bool

- Type boolean or **bool** represents logical statements
  - values: **True**, **False**
    - Boolean literals are just `True` and `False` (have to be capitalized)
  - operations: not, and, or
    - not b: **True** if b is false and **False** if b is true
    - b and c: **True** if both b and c are true; **False** otherwise
    - b or c: **True** if b is true or c is true; **False** otherwise
- Often come from comparing **int** or **float** values
  - Order comparison: i < j   i <= j   i >= j   i > j
  - Equality, inequality: i == j   i != j

"=" means something else!

Example: Type **str**

- Type String or **str** represents text
  - values: any sequence of characters
  - operation(s): + (catenation, or concatenation)
- **String literal**: sequence of characters in quotes
  - Double quotes: " abcex3$g<&" or "Hello World!"
  - Single quotes: 'Hello World!'
- Concatenation can only apply to strings.
  - 'ab' + 'cd' evaluates to 'abcd'
  - 'ab' + 2 produces an **error**

Converting Values Between Types

- Basic form: *type*(*value*)
  - `float(2)` converts value 2 to type **float** (value now 2.0)
  - `int(2.6)` converts value 2.6 to type **int** (value now 2)
  - Explicit conversion is also called "casting"
- Narrow to wide: **bool** ⇒ **int** ⇒ **float**
  - *Widening*. Python does automatically if needed
    - **Example**: `1/2.0` evaluates to 0.5 (casts 1 to **float**)
  - *Narrowing*. Python *never* does this automatically
    - Narrowing conversions cause information to be lost
    - **Example**: `float(int(2.6))` evaluates to 2.0