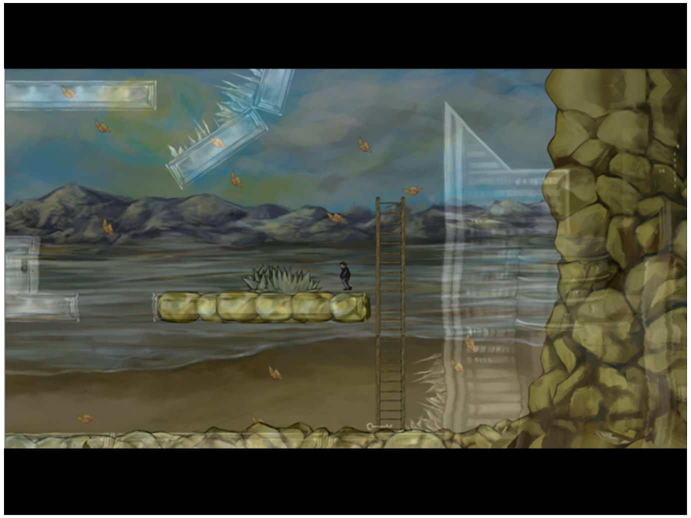
Lecture 1

Course Overview, Python Basics

We Are Very Full!

- Lectures 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 **a**t **C**ornell
  - Teach game design
- (and CS 1110 in fall)

CS 1110 Fall 2014

- **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/cs1110/2014fa/

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

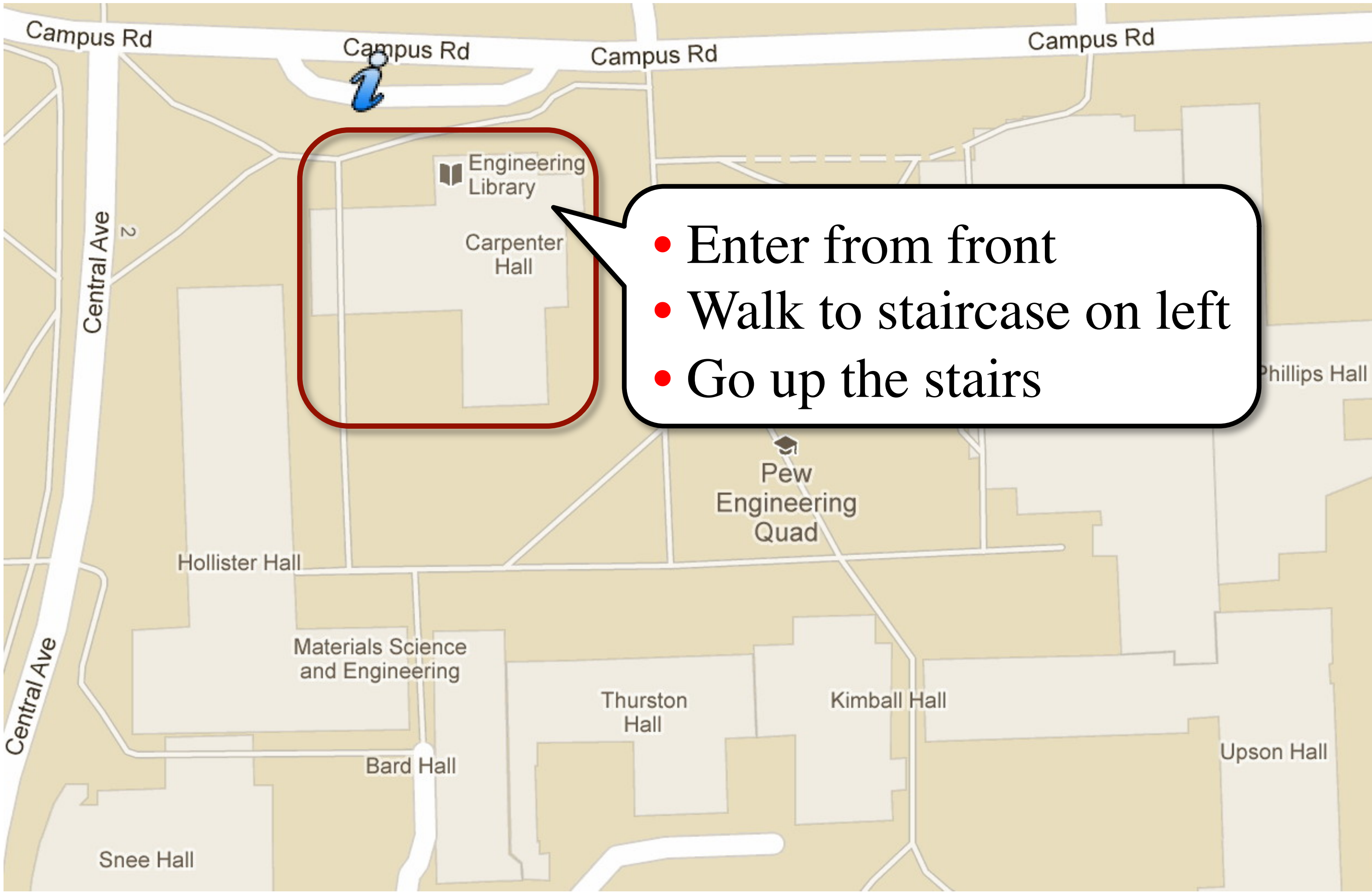
Why Programming in Python?

- 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 Jessica (jd648@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
  - Hardbound copies for sale in Campus Store
  - Book available for free as PDF or eBook
- **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** acceptable
- **Python.** Necessary if you want to use own computer
  - See course website for how to install the software

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/cs1110/2014fa/

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

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*

```
wmwhite
Last login: Tue Aug 19 14:36:29 on t
[wmwhite@Ryleh]:~ > python
Python 2.7.5 (default, Mar  9 2014,
[GCC 4.2.1 Compatible Apple LLVM 5.0
Type "help", "copyright", "credits"
>>> 1+2
3
>>> 'Hello'+'World'
'HelloWorld'
>>> 
```

This class uses Python 2.7.x
- Python 3 is too cutting edge
- Minimal software support

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 $\underbrace{5}_{\text{mantissa}} * 2^{\underbrace{-2}_{\text{exponent}}}$
- 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