Lecture 1

Course Overview, Python Basics

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 2019

- **Outcomes:**
  - **Fluency** in (Python) procedural programming
    - Usage of assignments, conditionals, and loops
    - Ability read and test programs from specifications
  - **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/cs1110/2019fa/

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

- 2-credit course in how to use Python
  - Material is roughly the first half of CS 1110
  - Most of the Python of 1110, but not theory
  - Two assignments; no exams
  - No experience required
- This is the only way to take Python S/U
  - CS 1110 is no longer offered S/U
  - Best for students that just want 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 or 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 Lacy (lsl92@cornell.edu) for section conflicts
  - **Mandatory**. Missing more than 2 lowers your final grade

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  - All Labs will be use the online system. But they are not intended to be "online".
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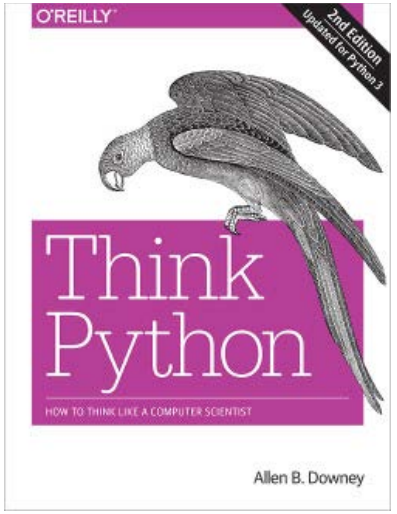
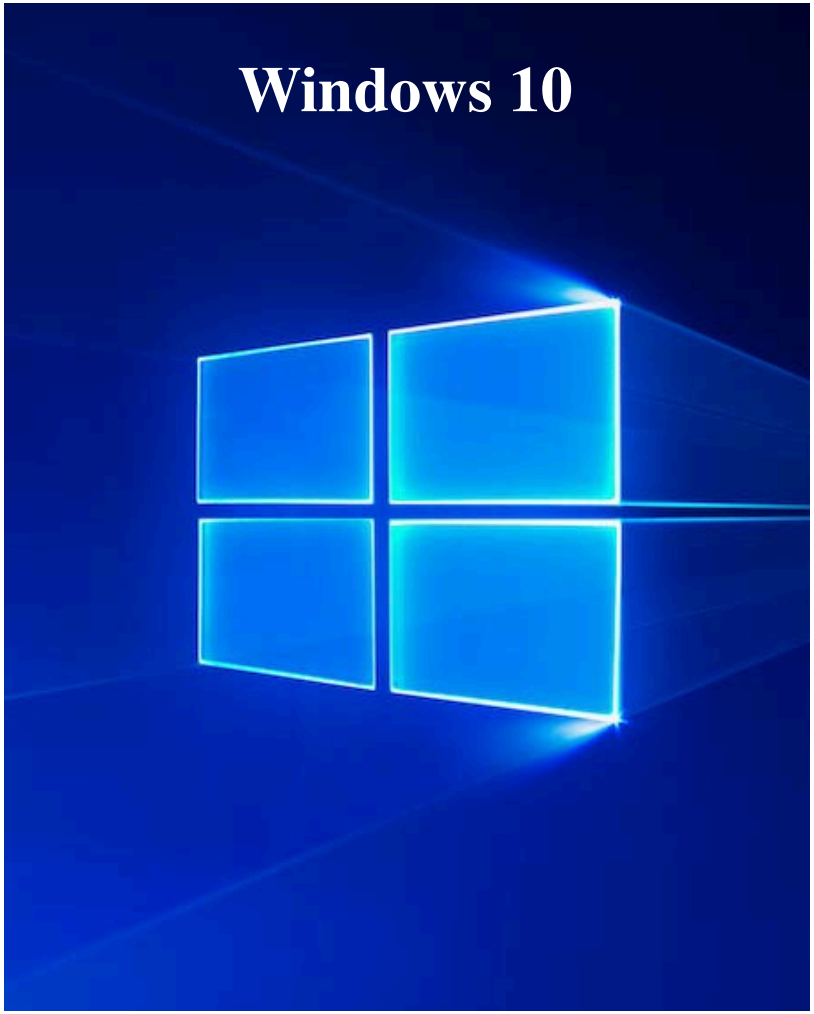
Class Materials

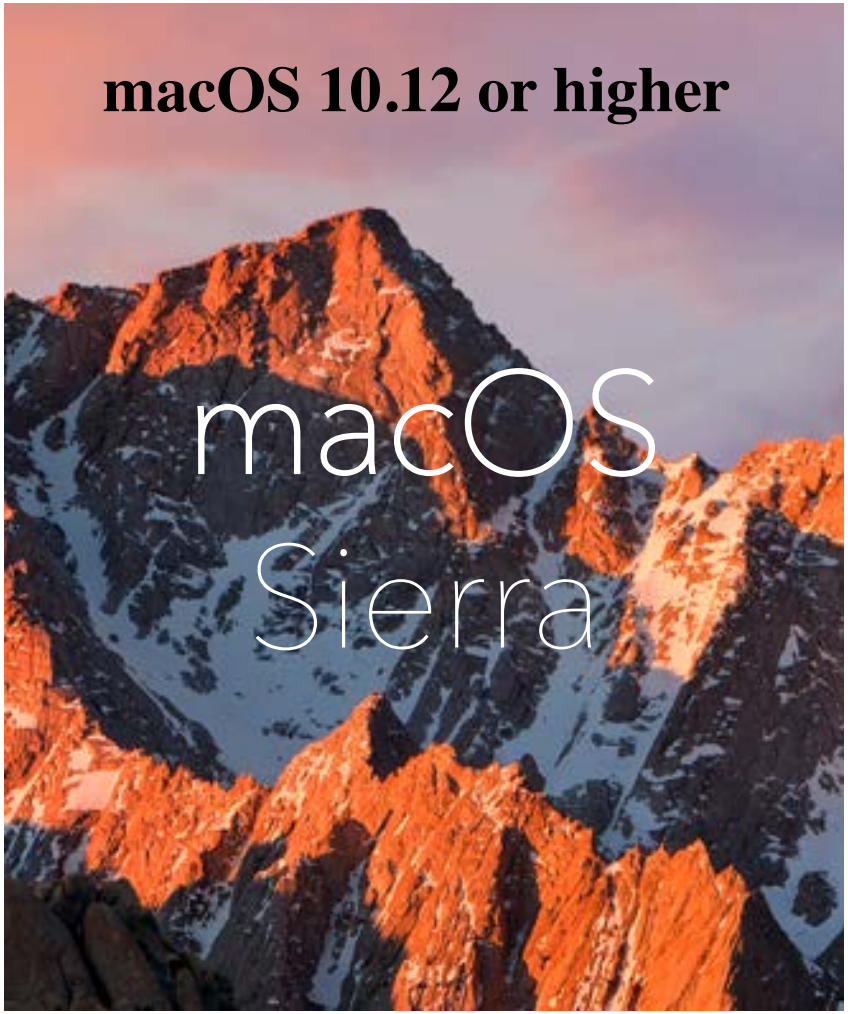
- **Textbook.** *Think Python, 2nd Ed.* by A. Downey
  - *Optional* text; only used as a reference
  - Available for free as PDF or eBook
  - Hardbound copies only available online



- **iClicker.** Acquire by **next Tuesday**
  - Credit for answering – even if wrong
  - iClicker App for smartphone **is not** acceptable
- **Python.** Necessary to use your own computer
  - See course website for how to install the software

This Course is OS Agnostic





Do NOT Even THINK It!

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Things to Do Before Next Class

- Visit the course website:
  - www.cs.cornell.edu/courses/cs1110/2019fa/
  - This IS the course syllabus, updated regularly
- Read **Get Started**
  - Obtain and *register* your iClicker
  - Enroll in Piazza
  - Sign into CMS and complete **Survey 0**
  - Install Python and complete **Lab 0**
  - Take the academic integrity quiz

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Will talk about this more next week

Some Words About About Grades

- This class is ***not*** curved (in traditional sense)
  - Curve = competition with other students
  - This is about material, not your classmates
- The grades mean something
  - **A**: mastered material; can be a consultant
  - **B**: good at material; can take 2110 (or major)
  - **C**: future CS courses are not a good idea
  - **D**: where did you go?
  - **F**: were you ever here?

Some Words About About Grades

- But this is **not** a weed-out course
  - We know students have different backgrounds
  - Students can do well regardless of experience
- But you may have to work hard!
  - If no experience, budget 10-12 hours of homework a week

	A	B	C	D/F	
All Students	**40%**	**40%**	**18%**	**2%**	
Some Experience	37%	41%	20%	2%	**42%**
No Experience	32%	42%	24%	2%	**28%**

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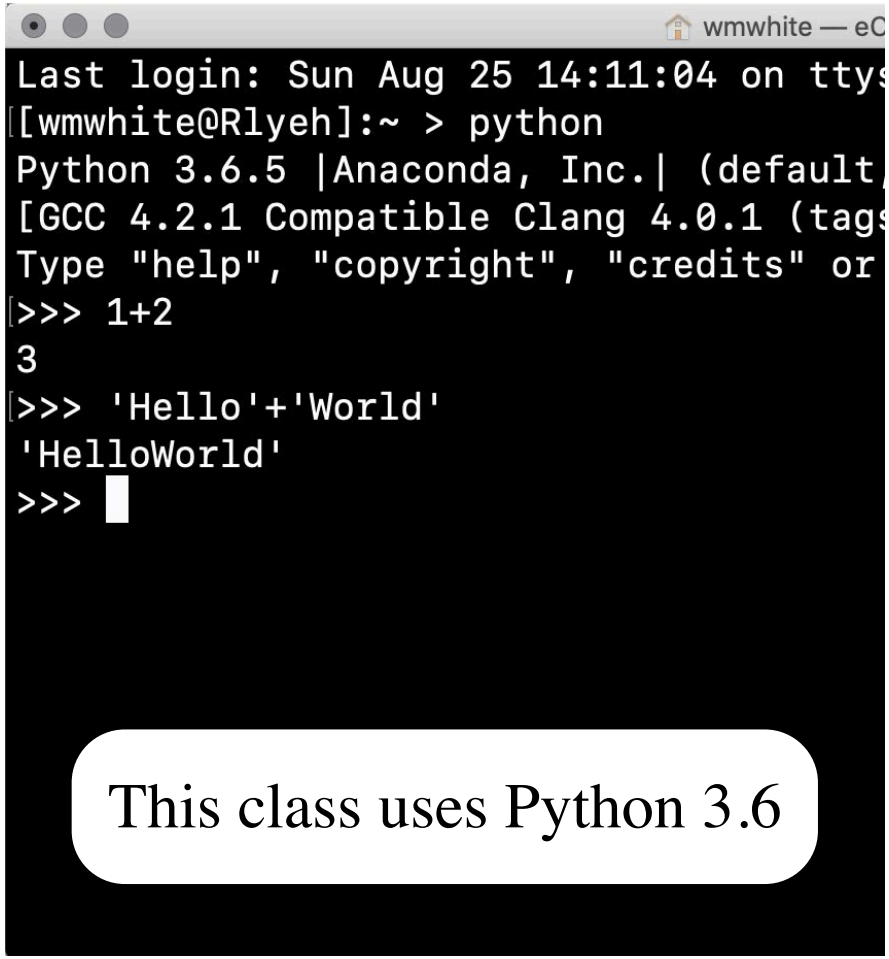
Freshmen, No Exp	**37%**	**39%**	24%	**0%**	

Getting Started with Python

- Will use the "command line"
  - OS X/Linux: **Terminal**
  - Windows: **PowerShell**
  - Purpose of the first lab
- Once installed type "python"
  - Starts an *interactive shell*
  - Type commands at >>>
  - Responds to commands
- Use it like a calculator
  - Use to evaluate *expressions*



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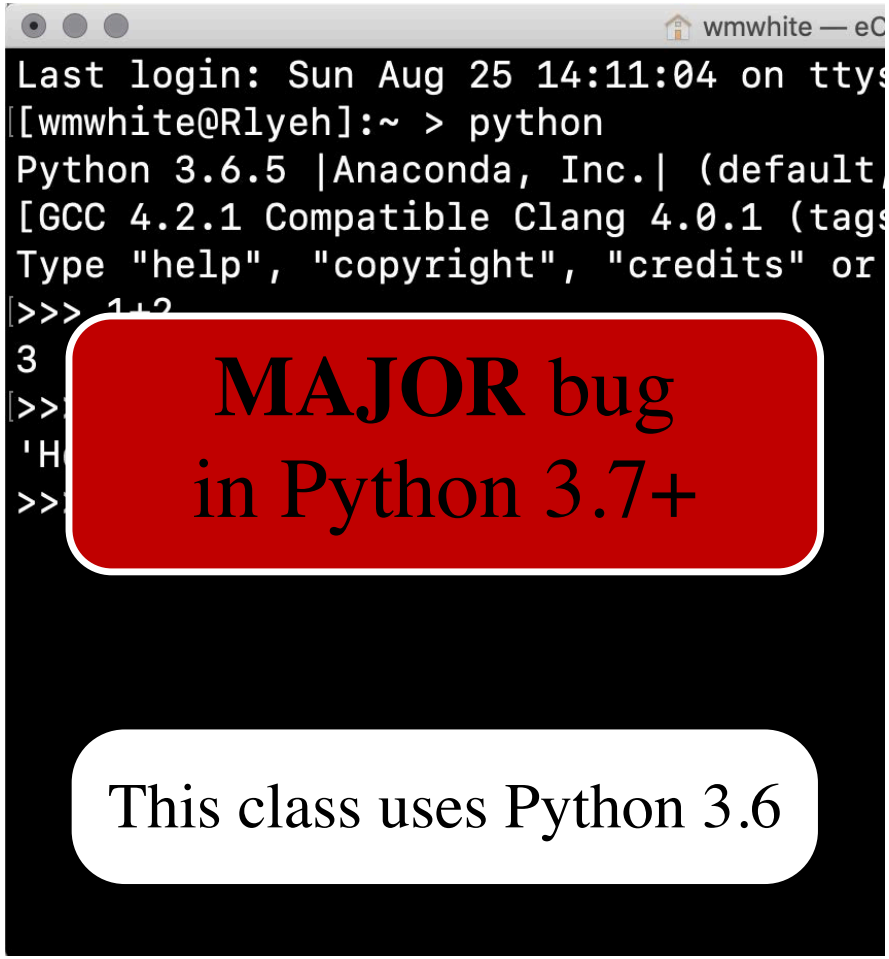
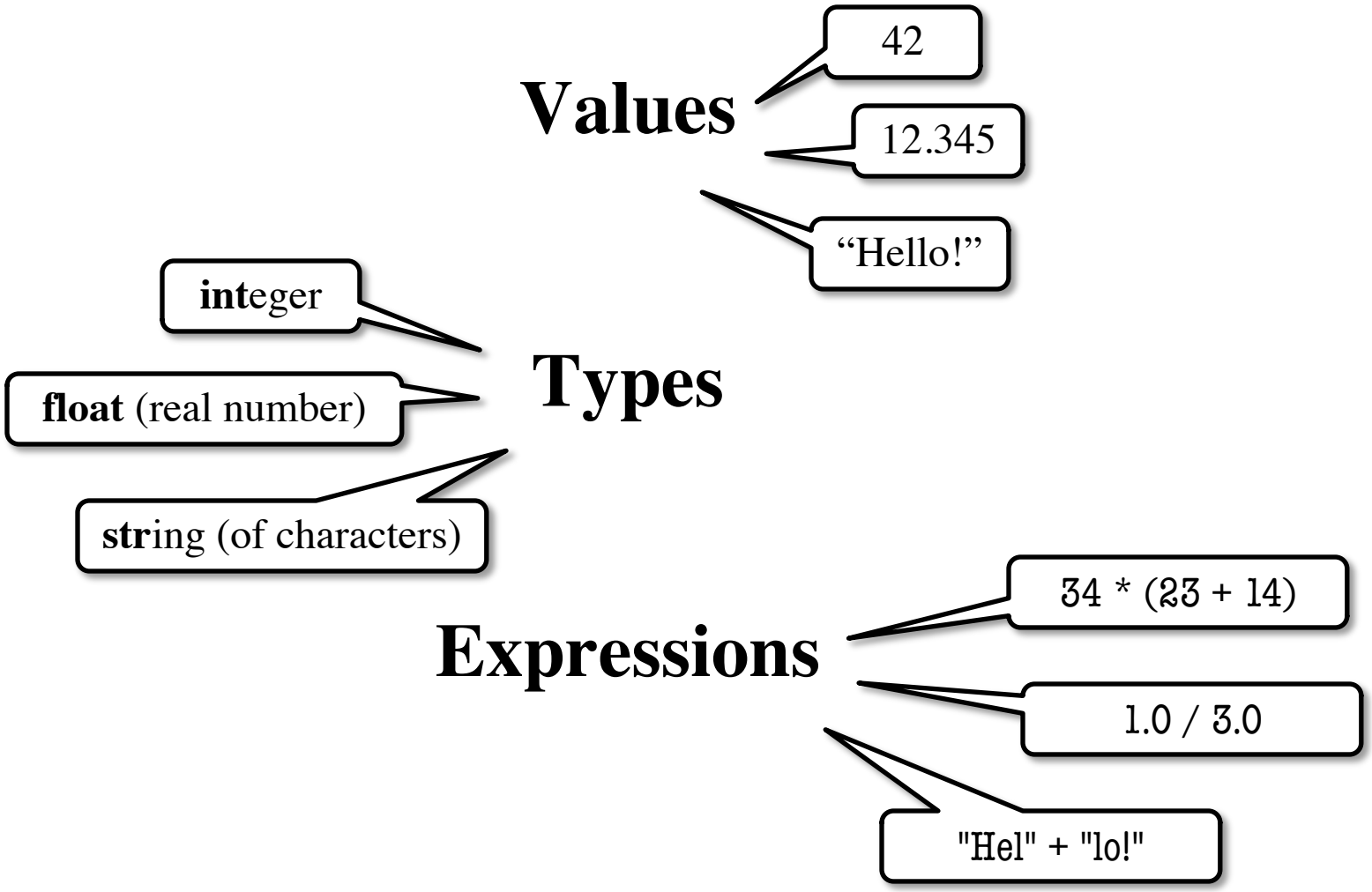


The Basics


Values
42
12.345
“Hello!”
Types
integer
float (real number)
string (of characters)
Expressions
34 * (23 + 14)
1.0 / 3.0
"Hel" + "lo!"

Expressions and Values

- An **expression** represents something
  - Python *evaluates it*, turning it into a **value**
  - Similar to what a calculator does
- Examples:

```
>>> 2.2
2.2
>>> (3 * 7 + 1) * 0.1
2.2
```

Expression (Literal)

Value

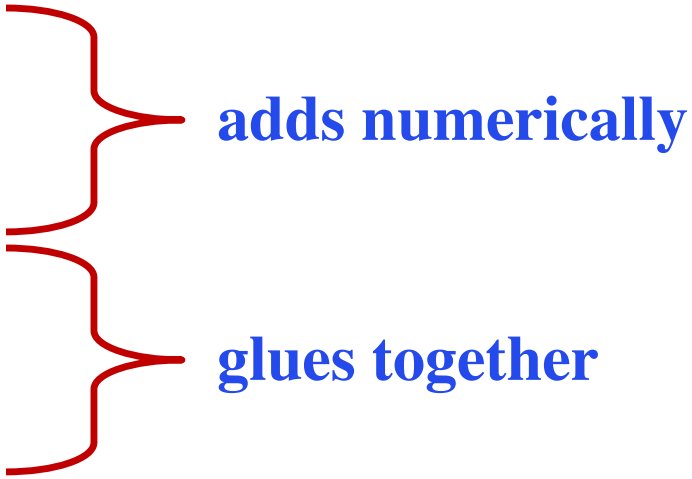
Expression (Complex)

Value

What Are Types?

- Think about + in Python:

```
>>> 1+2
3
>>> "Hello"+"World"
"HelloWorld"
```



- Why does + given different answers?
  - + is different on data of different ***types***
  - This idea is fundamental to programming

What Are Types?

A **type** is both

- a set of *values*, and
- the *operations* on them

Example: int

- **Values:** integers
  - …, –1, 0, 1, …
  - Literals are just digits:
    1, 45, 43028030
  - No commas or periods
- **Operations:** math!
  - +, − (add, subtract)
  - *, // (mult, divide)
  - ** (power-of)

Example: int

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- **Operations:** math!
  - +, − (add, subtract)
  - *, // (mult, divide)
  - ** (power-of)
- **Important Rule:**
  - **int** ops make **ints**
  - (if making numbers)
- What about division?
  - `1 // 2` rounds to 0
  - / is **not** an **int** op
- Companion op: %
  - Gives the remainder
  - `7 % 3` evaluates to 1

Example: float

- **Values:** real numbers
  - 2.51, -0.56, 3.14159
  - Must have decimal
  - 2 is **int**, 2.0 is **float**
- **Operations:** math!
  - +, − (add, subtract)
  - *, / (mult, divide)
  - ** (power-of)
- Ops similar to **int**
- **Division** is different
  - Notice /, not //
  - 1.0/2.0 evals to 0.5
- But includes //, %
  - 5.4//2.2 evals to 2.0
  - 5.4 % 2.2 evals to 1.0
- Superset of **int**?

float values Have Finite Precision

- Try this example:

```
>>> 0.1+0.2
0.30000000000000004
```

- The problem is **representation error**
  - Not all fractions can be **represented** as (finite) decimals
  - **Example**: calculators represent 2/3 as 0.666667
- Python does not use decimals
  - It uses IEEE 754 standard (beyond scope of course)
  - Not all decimals can be **represented** in this standard
  - So Python picks something close enough

float values Have Finite Precision

- Try this example:

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>>> 0.1+0.2
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```

- The proble
  - Not all f decimals
  - **Exampl**
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Expressions vs Values

int versus float

- This is why Python has two number types
  - **int** is **limited**, but the answers are always **exact**
  - **float** is **flexible**, but answers are **approximate**
- Errors in float expressions can propagate
  - Each operation adds more and more error
  - Small enough not to matter day-to-day
  - But important in scientific or graphics apps (high precision is necessary)
  - Must think in terms of **significant digits**

Using Big float Numbers

- **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

- Python *prefers* this in some cases

```
>>> 0.00000000001
1e-11
```

Remember: values look like **literals**

Example: bool

- **Values:** True, False
  - That is it.
  - Must be capitalized!
- **Three Operations**
  - b and c
    (True if **both** True)
  - b or c
    (True if **at least one** is)
  - not b
    (True if b is **not**)
- Made by **comparisons**
  - **int**, **float** operations
  - But produce a **bool**
- Order comparisons:
  - i < j, i <= j
  - i >= j, i > j
- Equality, inequality:
  - i == j (**not** =)
  - i != j

Example: str

- **Values:** text, or *sequence of characters*
  - String literals must be in quotes
  - Double quotes: "Hello World!", " abcex3$g<&"
  - Single quotes: 'Hello World!', ' abcex3$g<&'
- **Operation:** + (catenation, or concatenation)
  - 'ab' + 'cd' evaluates to 'abcd'
  - concatenation can only apply to strings
  - 'ab' + 2 produces an **error**