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 2024

- **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/cs1110/2024fa/

Intro Programming Classes Compared

CS 1110: Design & Dev

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

CS 1112: Engineering Sci.

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

But both are taught in **Python**!

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
- The preferred course for **grad students**
  - Only lasts half of a semester
  - Over just before research gets in the way

Class Structure

- **Lectures.** Every Tuesday/Thursday
  - Not just slides; interactive demos almost every lecture
  - Technically, you can attend either section
  - **Semi-Mandatory**. 1% Participation grade from iClickers
- **Section/labs.** See roster for room.
  - Guided exercises with TAs and consultants helping out
    - Meets Tuesday/Thursday or Wednesday/Friday
    - **Only Phillips 318 has computers** (bring your laptop)
  - You can change section, but there is no waitlist
  - **Mandatory**. Missing more than 3 lowers your final grade

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- **Section/labs.** See roster for room.
  - All Labs will be use the online system.
    But they are not intended to be "online".
  - You can change section, but there is no waitlist
  - **Mandatory**. Missing more than 2 lowers your final grade

Is there a TextBook?

No

Is there a TextBook?

NO

The asynchronous videos are *essentially* the textbook

What Do I Need for this Class?

- **Laptop Computer**
  - Capable of running Python (no ChromeBooks!)
  - Minimum of 8Gb of RAM
- **Python Installation**
  - Will be using the latest Anaconda version
  - See instructions on website for how to install
- **iClicker.** Acquire by **this Thursday**
  - Credit for answering – even if wrong
  - iClicker App for smartphone **is not** acceptable

What Do I Need for this Class?

- **Laptop Computer**

You can use computers in Phillips 318 if needed.

- **iClicker.** Acquire by **this Thursday**
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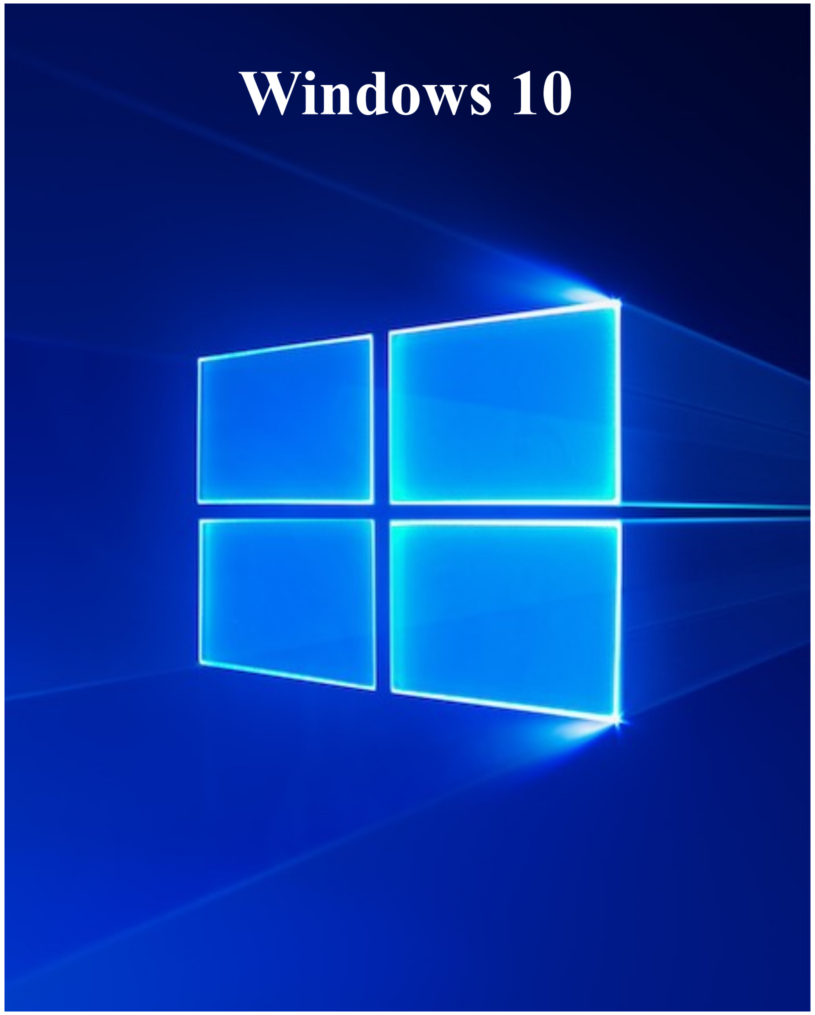
The only MUST purchase

This Course is OS Agnostic



Do NOT Even THINK It!

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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; ready to take 2110
  - **C**: it is a bad idea to take 2110
  - **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!
  - Budget 10-12 hours of homework a week
  - More experience means less time needed
- Course **is not curved**, but grades are fair

Distribution past few years

A grades	B grades	C grades	D-F grades
40%	40%	19%	1%

Exams: The Bad News

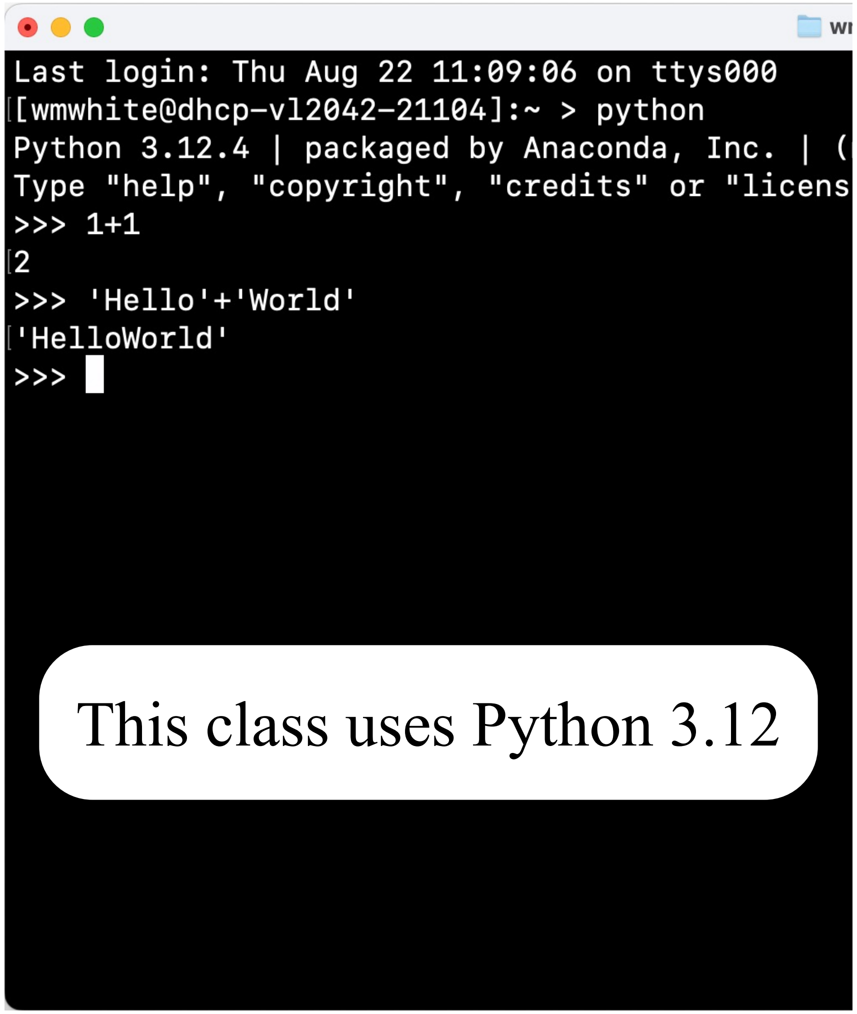
- We do not pick exam dates; Central Admin does
  - Big classes are spread across many rooms
- This year, we got the worst times in a decade
  - Second prelim is December 5 (last day of class)
  - First prelim is four days after **drop deadline**
- **Solution:** We are giving up our rooms!
  - We will have a **COVID-style online prelim**
  - This allows us to be before drop deadline

Things to Do Before Next Class

- Visit the course website:
  - www.cs.cornell.edu/courses/cs1110/2024fa/
  - This IS the course syllabus, updated regularly
- Read **Get Started**
  - Enroll in **Ed Discussions**
  - Register your **iClicker** online
  - Install Python and complete **Lab 1**
- Will cover **course policies** next time

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*



```
Last login: Thu Aug 22 11:09:06 on ttys000
[wmwhite@dhcp-vl2042-21104]:~ > python
Python 3.12.4 | packaged by Anaconda, Inc. | (
Type "help", "copyright", "credits" or "licens
>>> 1+1
2
>>> 'Hello'+'World'
'HelloWorld'
>>> 
```

This class uses Python 3.12

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
```

`>>> 2.2`	**Expression**	**(Literal)**
`2.2`	**Value**	
`>>> (3 * 7 + 1) * 0.1`	**Expression**	**(Complex)**
`2.2`	**Value**	

What Are Types?

- Think about + in Python:

```
>>> 1+2
3
```

adds numerically

```
>>> "Hello"+"World"
"HelloWorld"
```

glues together

- 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

- **Values:** integers
  - …, –1, 0, 1, …
  - Literals are just digits: 1, 45, 43028030
  - No commas or periods
- **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 0.66666**7**
- 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:

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

- The proble
  - Not all f
  - **Exampl**

Expressions vs Values

decimals

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  - Not all decimals can be **represented** in this standard
  - So Python picks something close enough

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**