The Python Language (Part 1)

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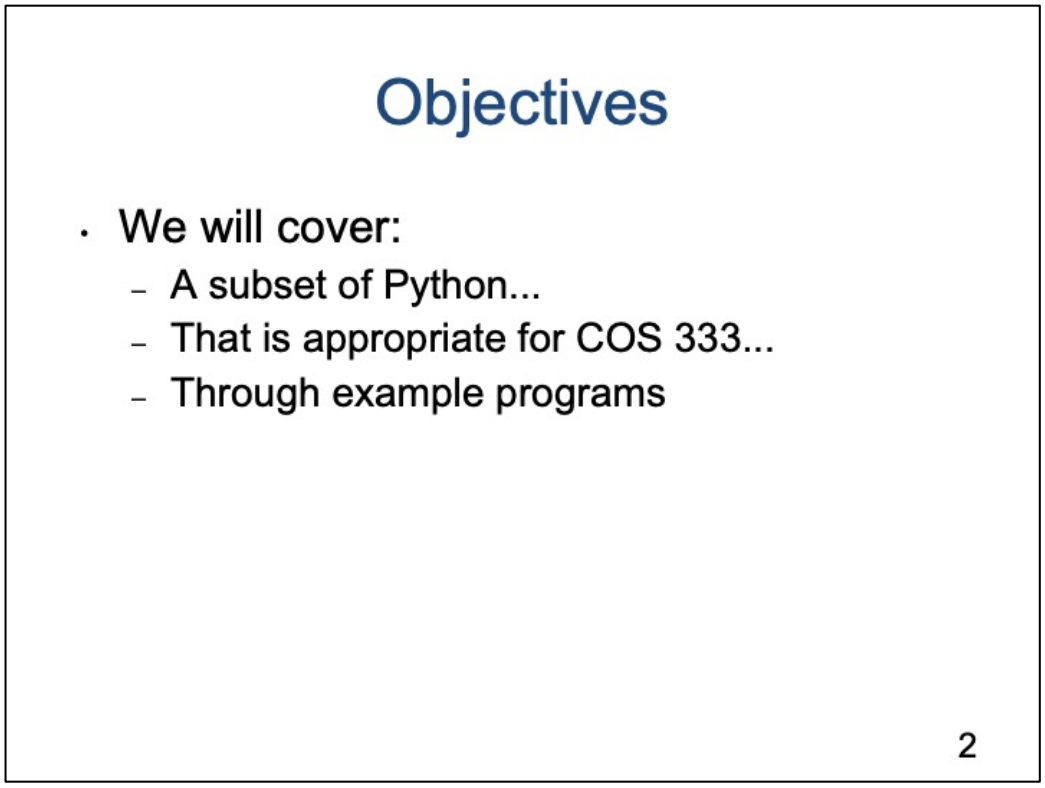

Objectives

We will cover:

A subset of Python...
That is appropriate for COS 333...
Through example programs

Note:

Comprehensive coverage is impossible!
Please supplement with reading

Agenda

- **Overview**
- Setup
- Simplest program
- Building and running
- Functions
- Standard library
- Interactive Python

Overview

- **Who**: Guido Van Rossum
- **When**: ~1990
- **Why**: Scripting lang for C/Unix pgmmers

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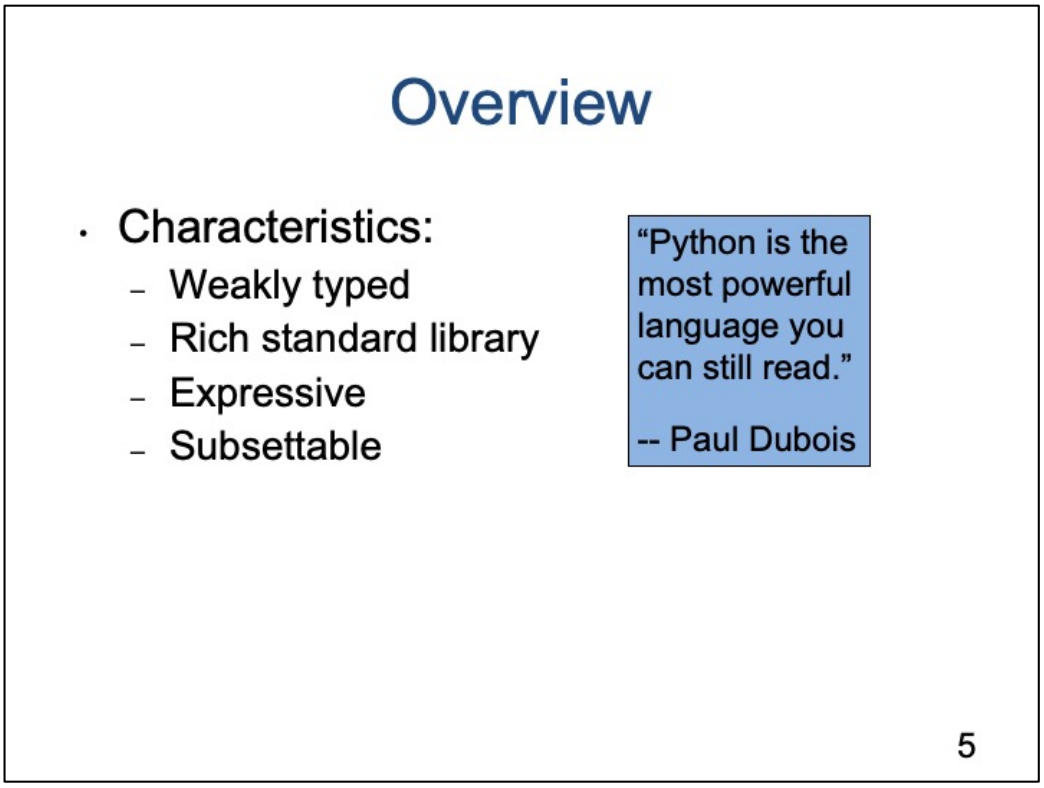
Overview

Who: Guido Van Rossum
- A fan of Monty Python's Flying Circus
- Python documentation often uses examples derived from Monty Python's Flying Circus
  - Dead parrots
  - Spam

When: ~1990
- A contemporary of Java!

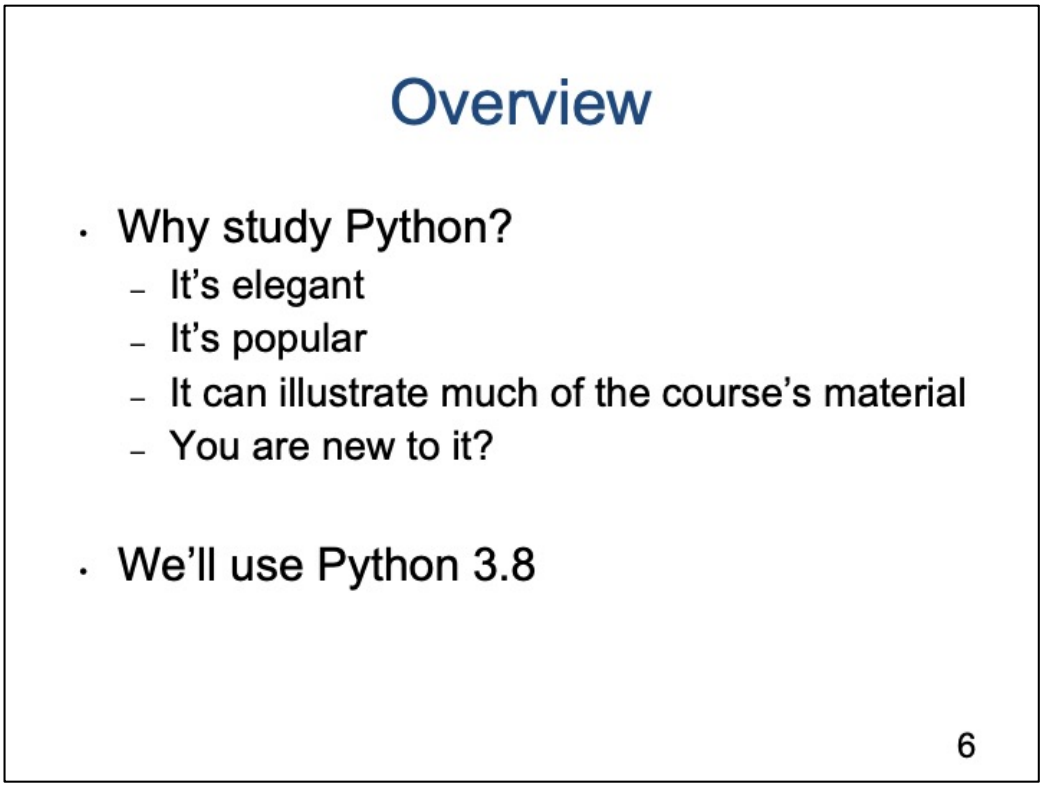
Why: Scripting language for C/Unix programmers
- Scripting language
  - Need not declare variables before using them
  - Interpreted
- Designed such that C programmers are comfortable with its features



Overview

Characteristics

- Weakly typed
  - Objects have types, object refs do not
  - Object refs are not declared
- Rich standard library
  - Often poorly documented
  - Often uses inconsistent pgmming conventions
  - The Python standard library is a mess
- Expressive
  - Can accomplish much work with little code
- Subsettable
  - Consider "Hello world" pgm in Java vs. in Python!



Overview

Why study Python?
- Elegant
  - Python libraries are messy, but language itself is clean.
- Popular
  - And is gaining in popularity
- Can illustrate much of the course's material
  - But not client-side web pgmming
  - But not Android pgmming
- You are new to it?

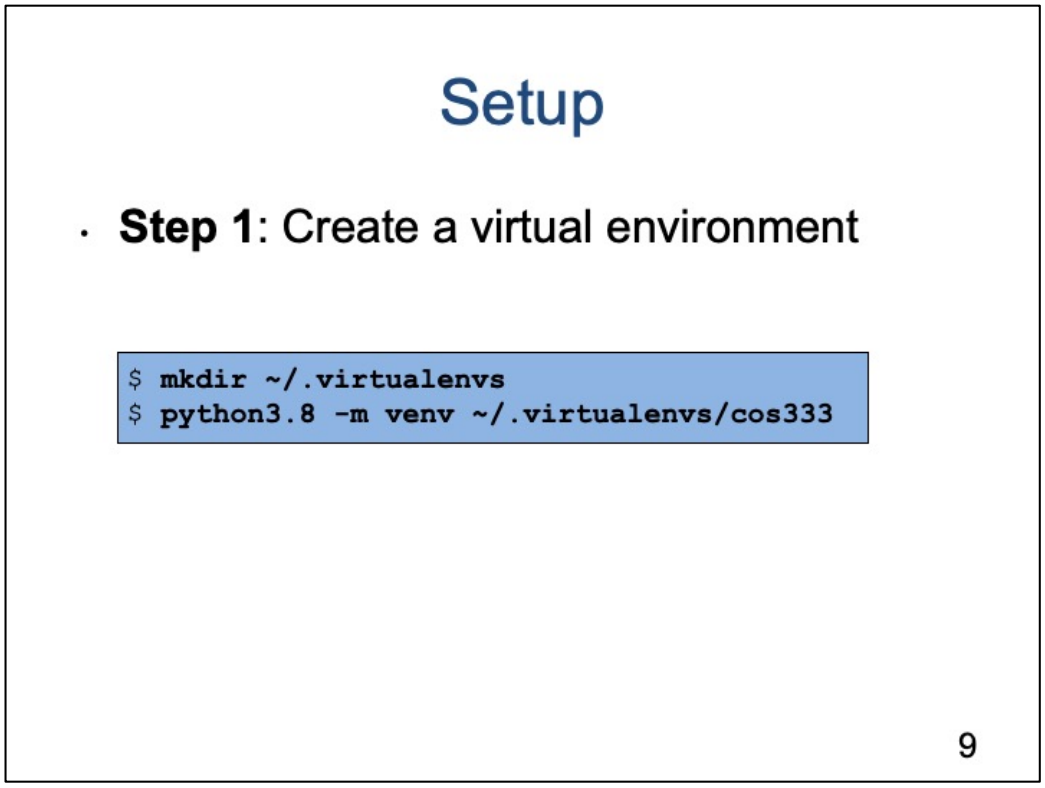
We'll use Python 3.8
- Python 2.x will not work
  - No longer supported as of 1/1/20
- Python 3.6, 3.7, 3.9, or 3.10 probably will work, but no guarantees

Agenda

- Overview
- **Setup**
- Simple programs
- Building and running
- Functions
- Standard library
- Interactive Python

Setup

- How to setup a Python environment on **courselab**…
- See *A COS 333 Computing Environment* (from first lecture) for:
  - More detailed instructions
  - Instructions to setup a Python environment on **your** computer
- The general idea…

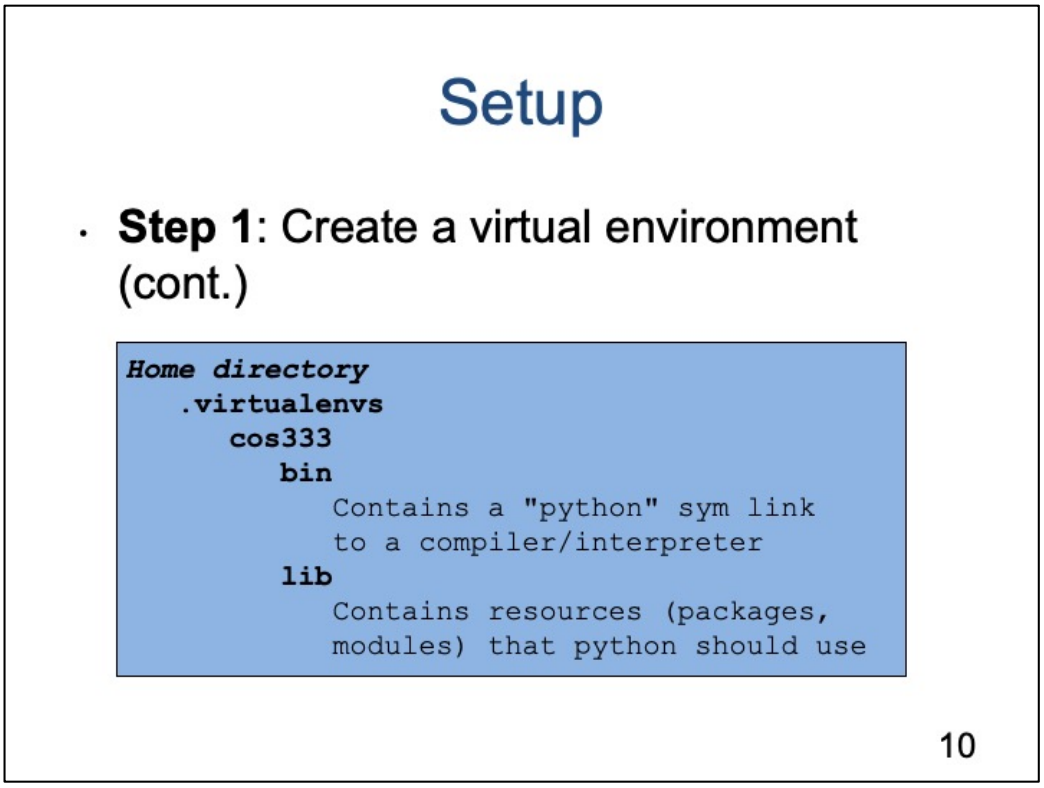


Setup

Step 2: Create a virtual environment

Issue these commands

[see slide]



Setup

Step 2: Create a virtual environment

Those commands create a directory structure

[see slide]

Don't install resources into the directory used by the compiler/interpreter bundled with the OS
Doing so could affect the behavior of programs bundled with the OS

Setup

Step 3: Activate your virtual environment

[see slide]

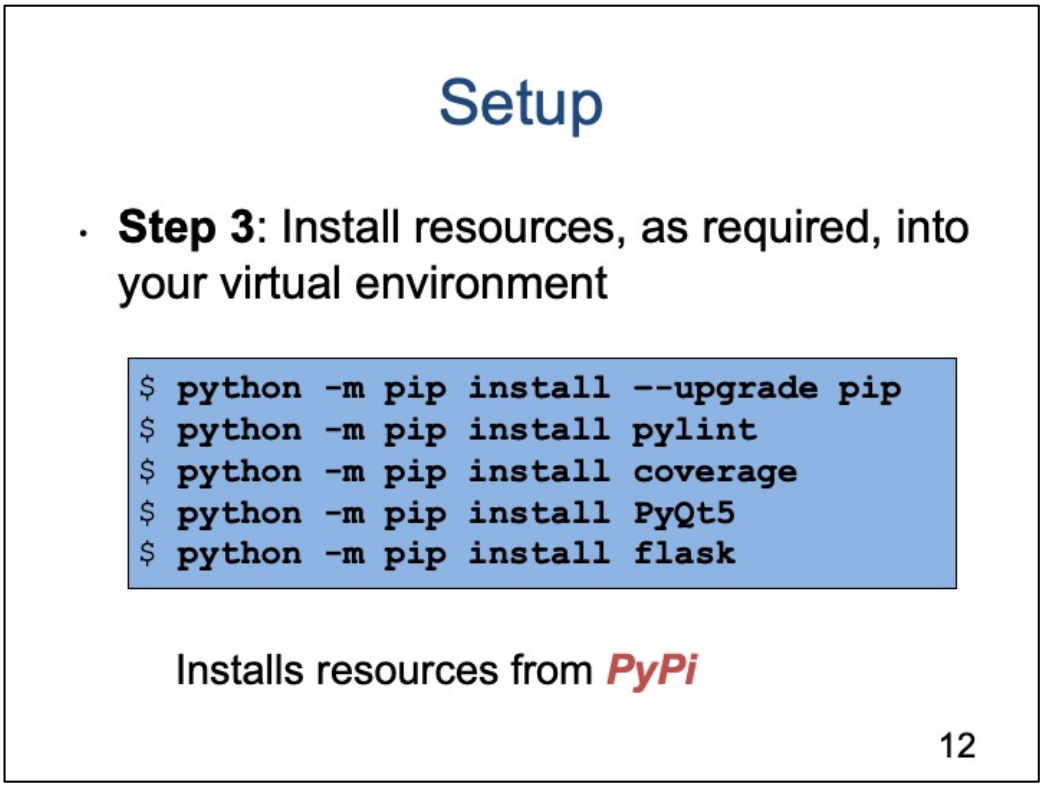
Adds your bin directory to front of `PATH` env var

Thereafter `python` command runs the compiler/interpreter in your bin directory

Specified compiler/interpreter uses your lib directory to find resources

Defines a shell alias `deactivate`

`Make sure you know about the shortcut`



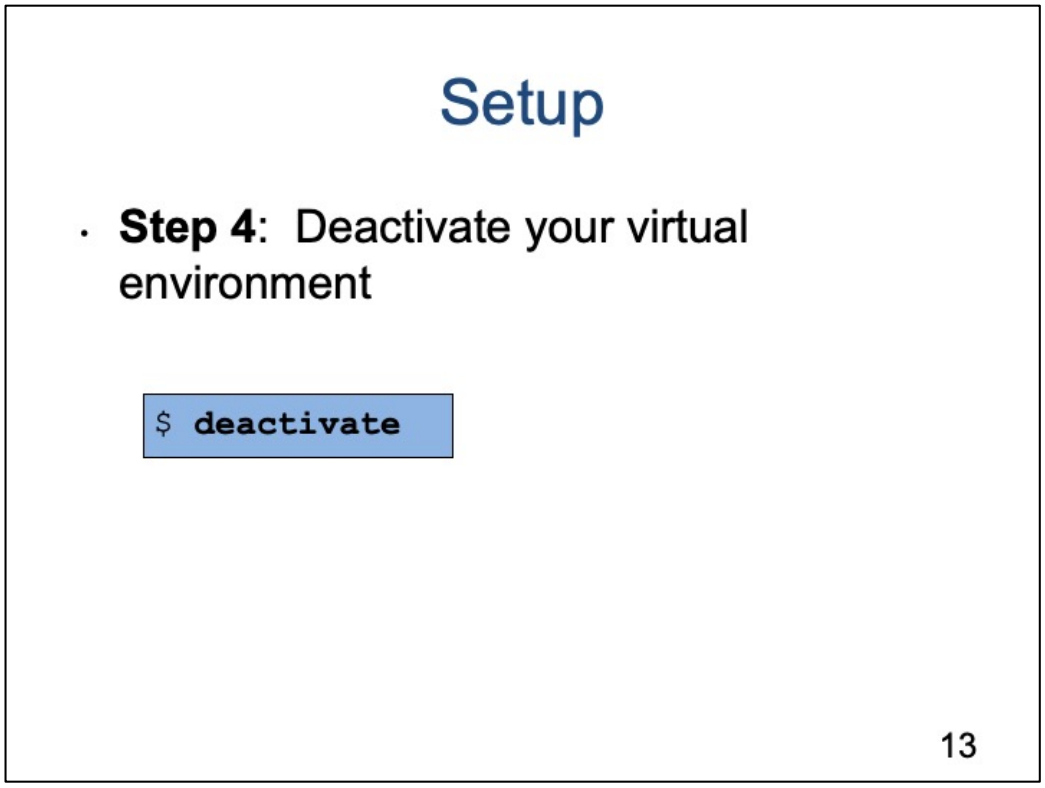
Setup

Step 4: Install resources, as required, into your virtual environment

[see slide]

Uses ***pip*** (Python package installer) program

Installs packages from ***PyPi*** (Python package index) into your lib directory



Setup

Deactivate your virtual environment

[see slide]

On Unix-like systems
Runs deactivate shell alias

Restores PATH env var to its default

Setup

- **Thereafter**:

```
$ activate333

(Use Python as desired)

$ deactivate
```

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- **Simple programs**
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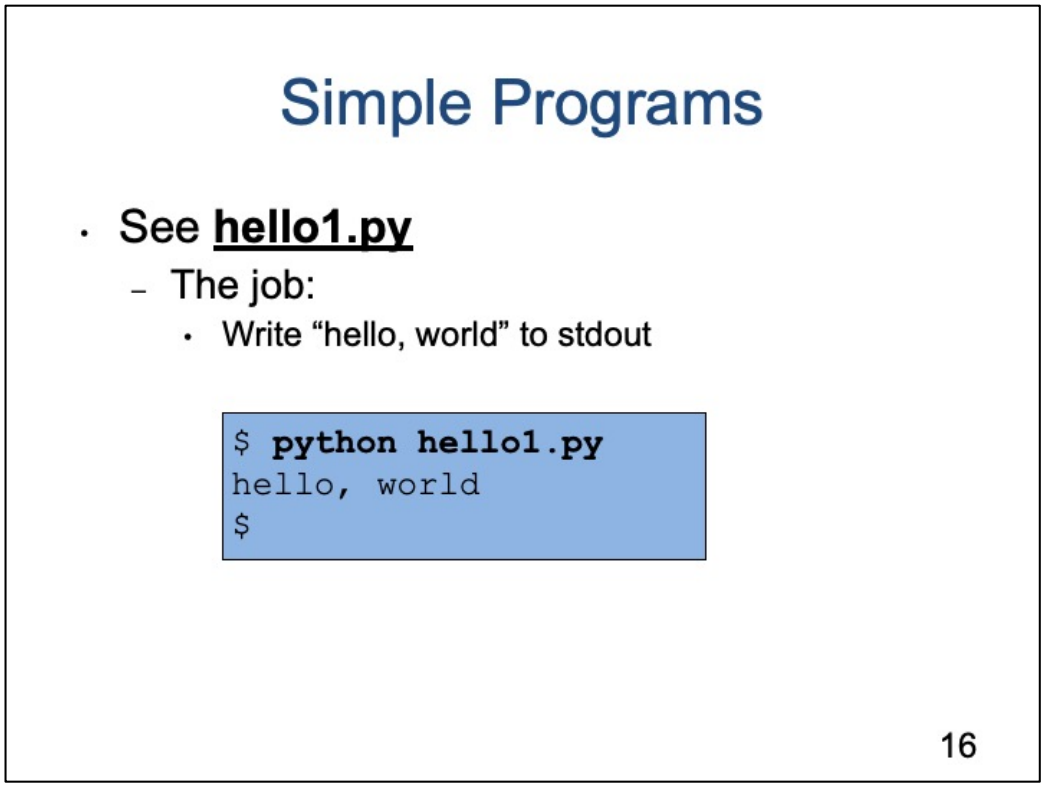
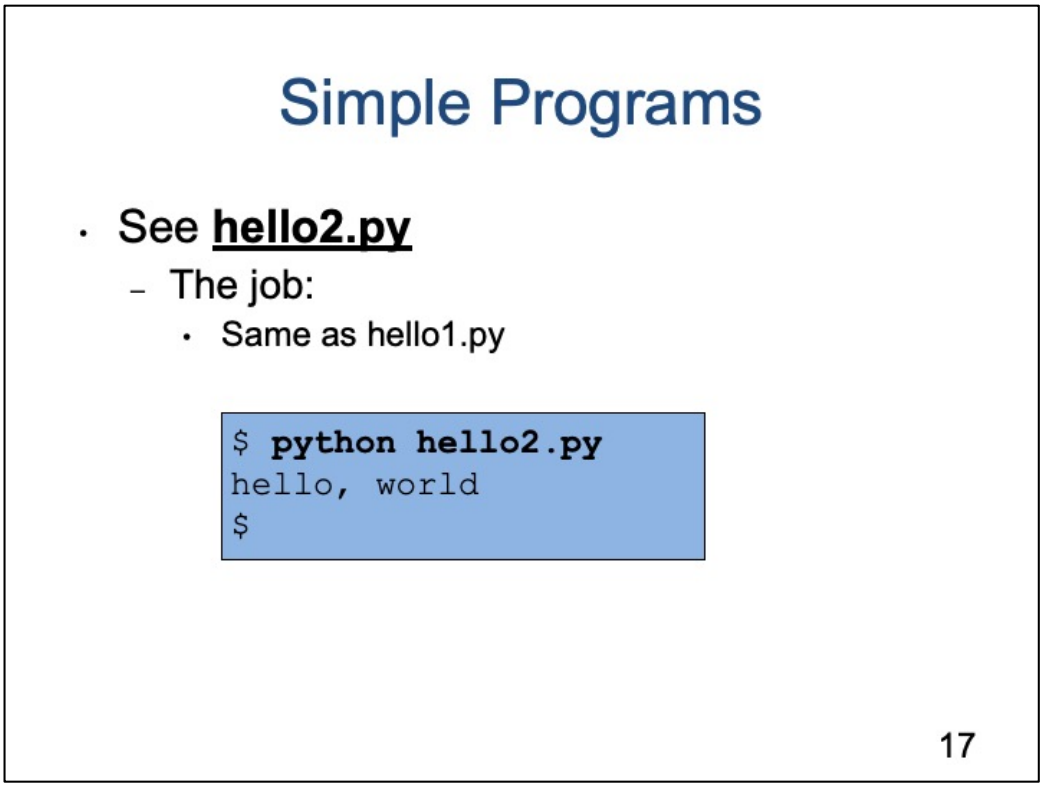


Simple Programs

[see slide]

Notes:

Overall structure (minimal!)
Program consists of statements
Generally, each statement is on a distinct line
`#!/usr/bin/env python`
She-bang line
Meaningful on Unix-like systems
Meaningless (but harmless) on MS Windows systems
Commands `execvp()` to...
Use the `python` program
Search the `PATH` env var to find it
Comments (#...)
`print()` function
String literal ('…' or "...")
No semicolons!!!



Simple Programs

[see slide]

Notes:

Function definitions and calls

`__name__ == '__main__'`

True if this module is the “main” module

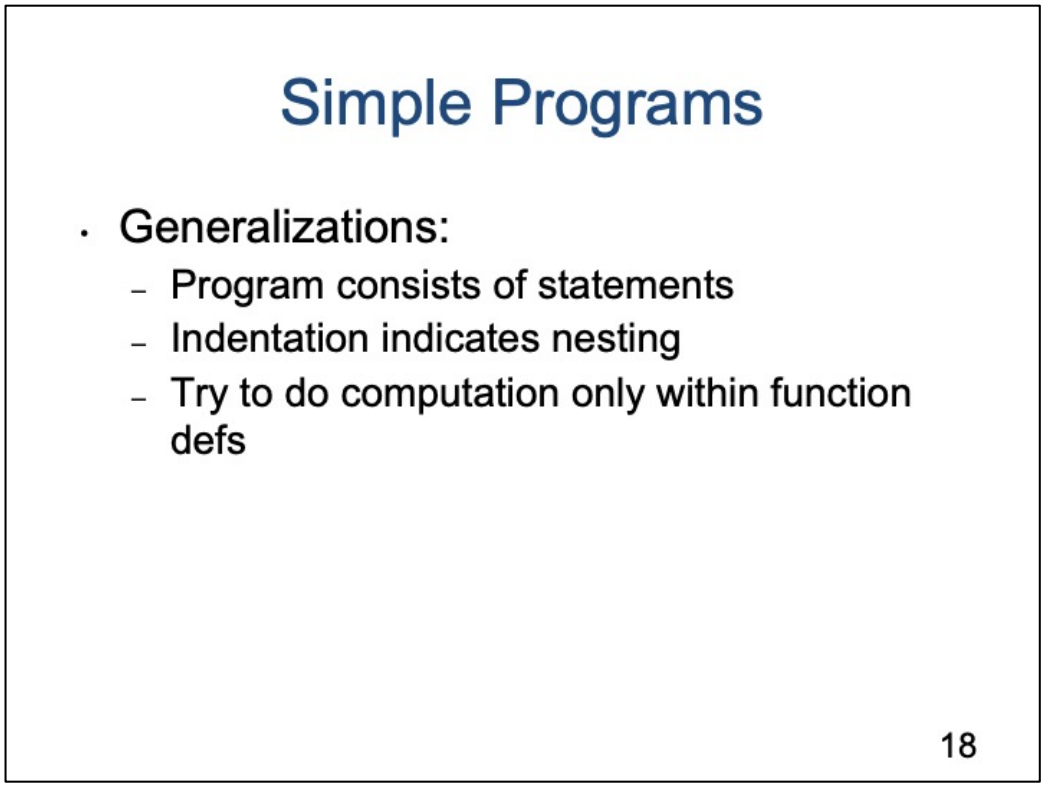
True if this module is being interpreted directly from the command-line

False if this module is being interpreted via an import statement into another module (via an import stmt)

Indentation matters!!!

Function comments are important, but…

I’ll omit from lecture example programs to save space/paper



Simple Programs

Generalizations

Program consists of statements
    Some of which are function defs
Indentation indicates nesting
    Throwback to the early days of programming
Try to do computation only within function defs
    File more reasonably can be included into others
    Avoid some anomalies

I'll use the style of hello2.py consistently throughout the course

Agenda

- Overview
- Setup
- Simple programs
- **Building and running**
- Functions
- Standard library
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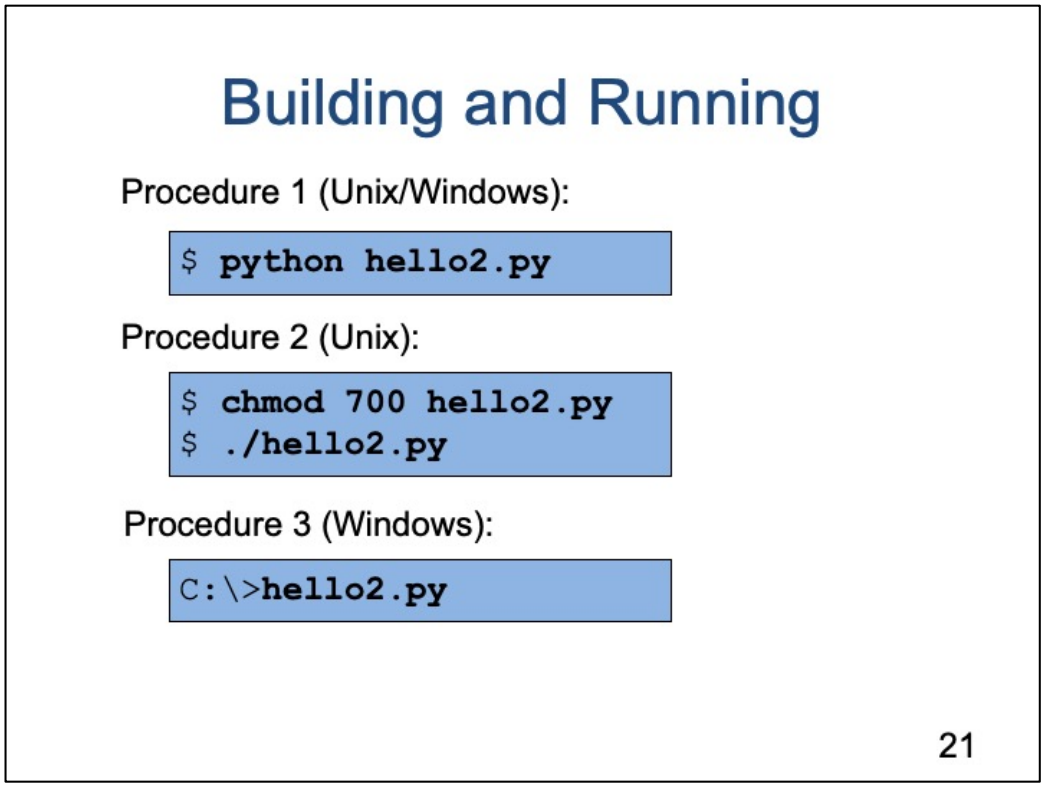
Building and Running

- Initially…
  - Activate your cos333 virtual environment



Building and Running

Procedure 1 (Unix/Windows)

```
$ python hello2.py
```

Works with or without #! line

Procedure 2 (Unix)

```
$ chmod 700 hello2.py
```

See *Unix File and Directory Permissions* doc
700 => 111000000
User has read, write, execute permissions
Members of user's group have no permissions
Others have no permissions

$ ./hello2.py

Works only with #! line

Procedure 3 (Windows)

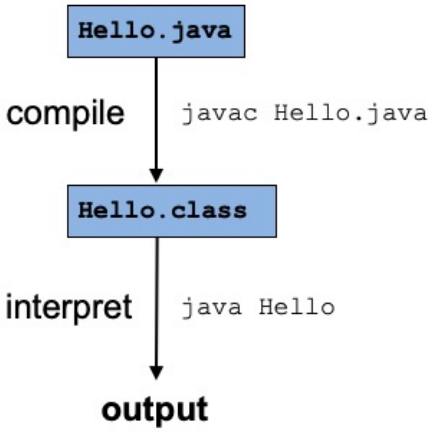
```
C:\>hello2.py
```

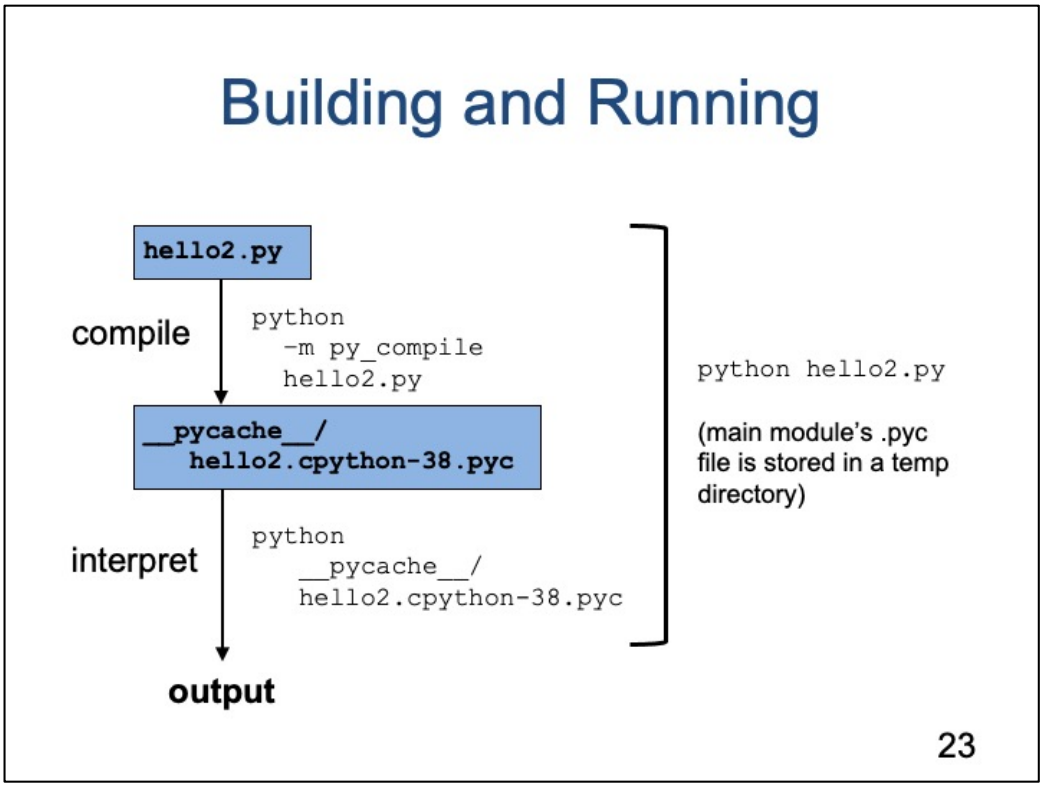
Windows is sensitive to filename suffix

Works with or without #! line (which MS Windows ignores)

Throughout the course I'll stick with procedure 1 as much as possible

Aside: Building and Running with Java





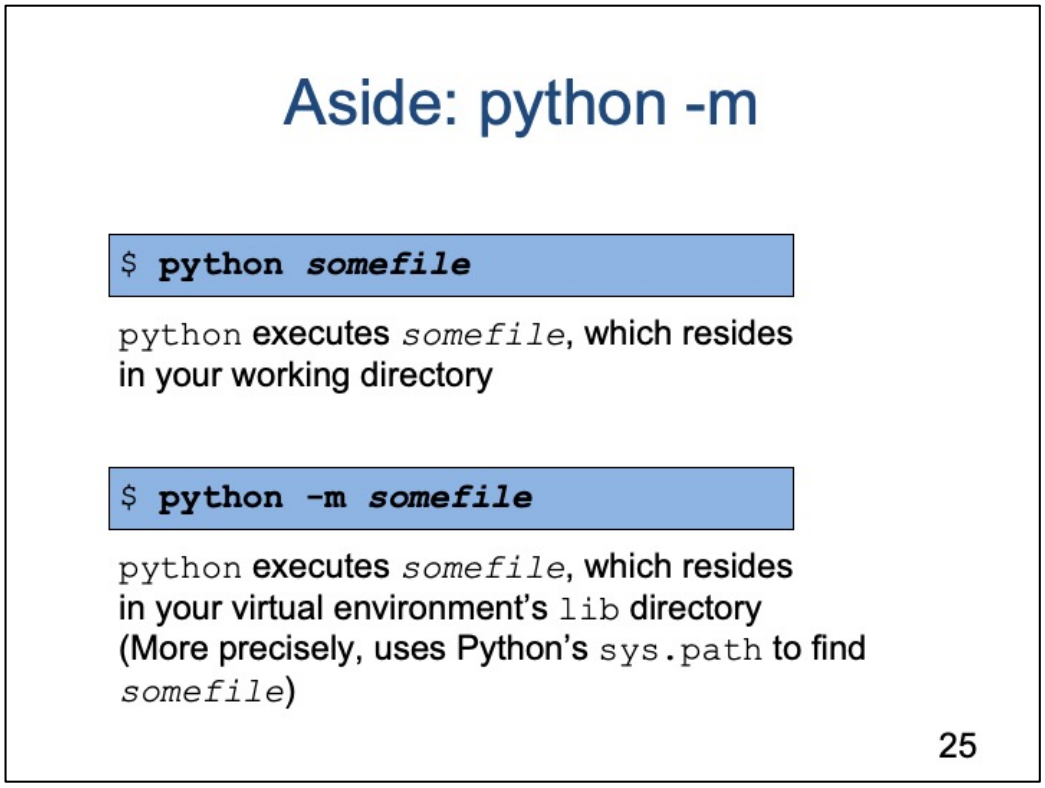
Building and Running

[see slide]

You won't see a __pycache__ directory or .pyc files until you start importing Python modules that you compose
We'll study the import statement soon

Building and Running

- Finally…
  - Deactivate your cos333 virtual environment



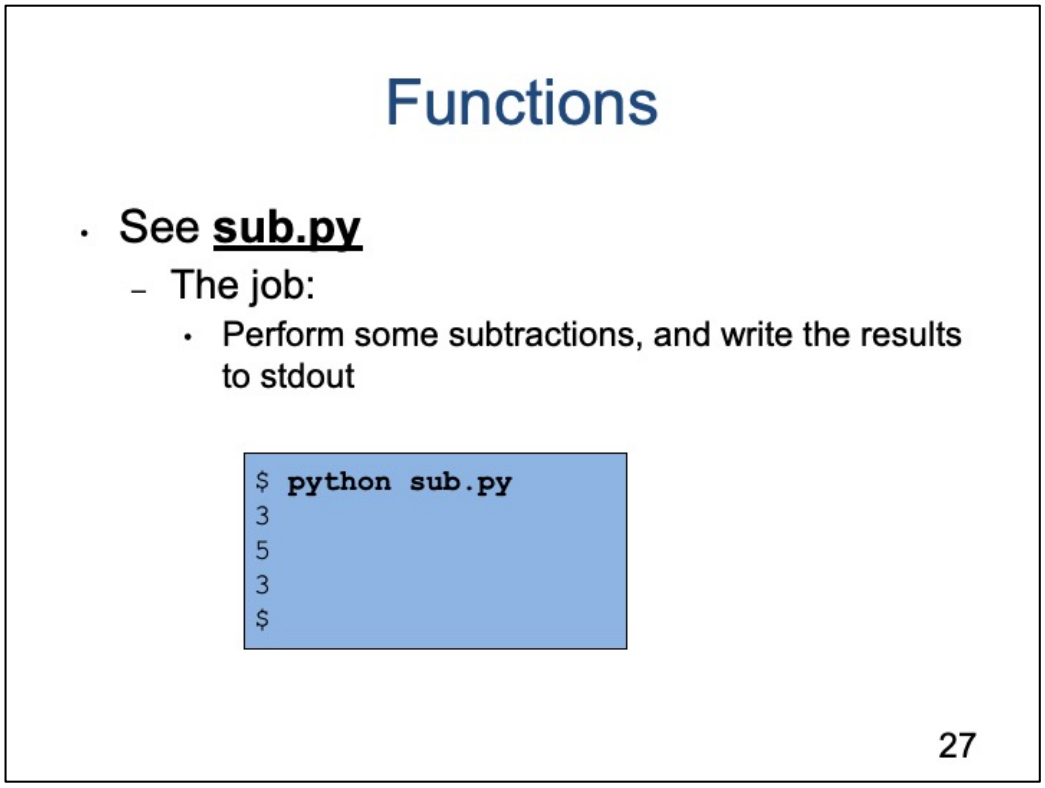
Aside: python –m

[see slide]

In the light of that information, the commands that you issued to install resources make more sense

Agenda

- Overview
- Setup
- Simple programs
- Building and running
- **Functions**
- Standard library
- Interactive Python



Functions

[see slide]

Notes:

A program can define multiple functions
Weakly typed
    Parameter types are not declared
Call is by value
Fancy function features:
    Default parameter values
    Named arguments

Agenda

- Overview
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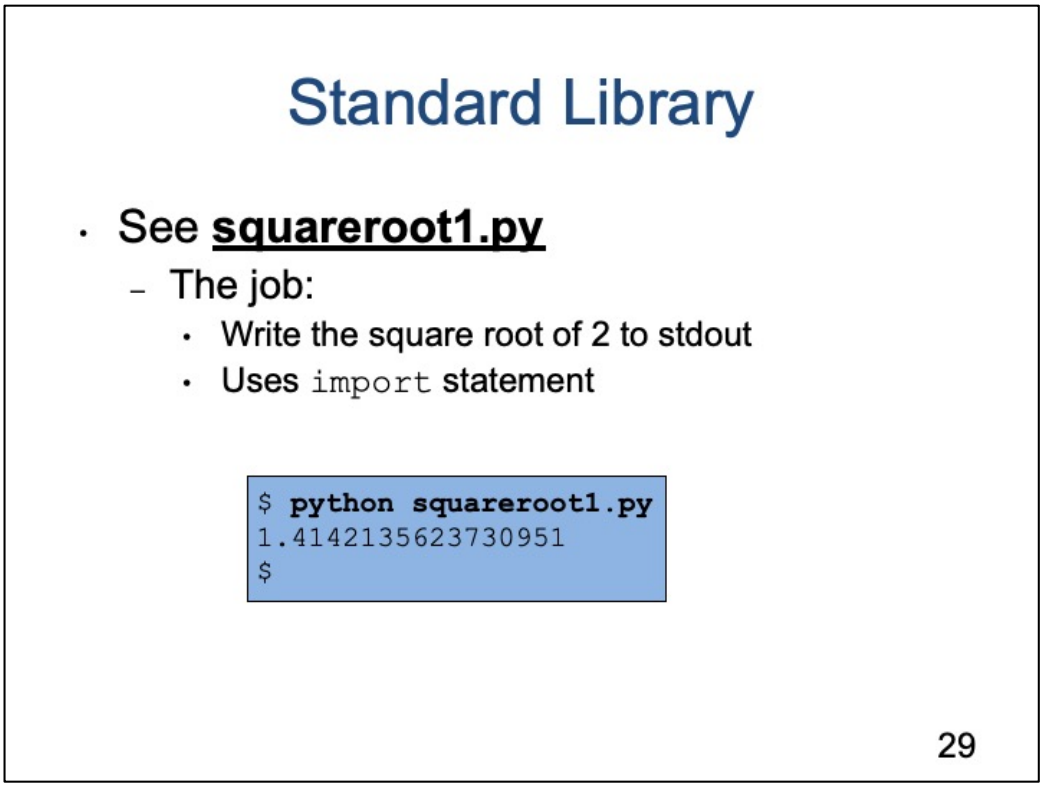
- **Standard library**
- Interactive Python



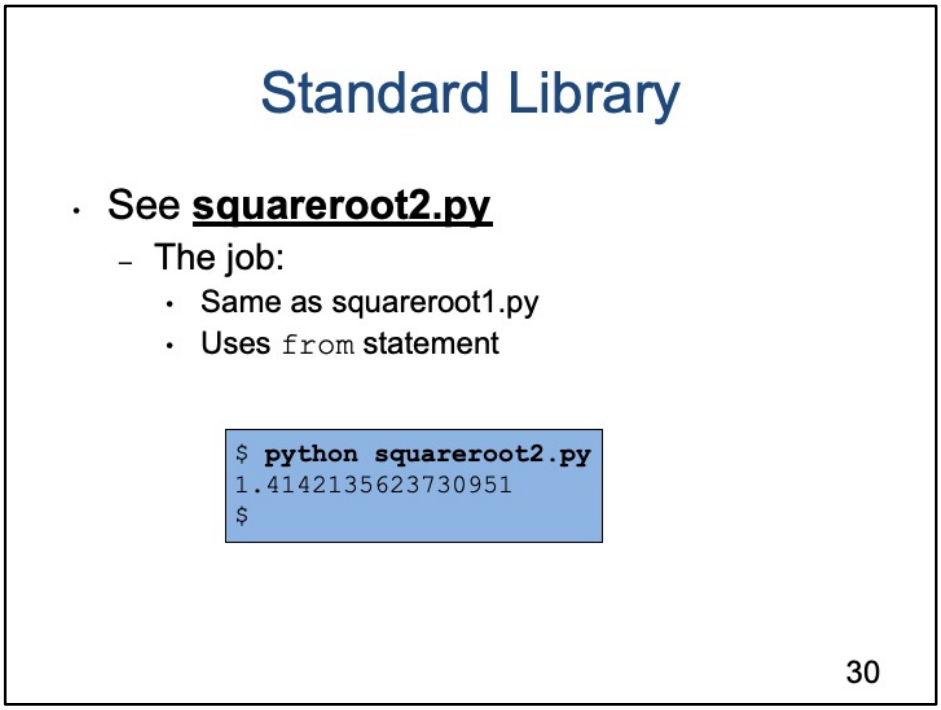
Standard library

[see slide]

Notes:

`import math`

Commands interpreter to interpret the contents of `math.py` (or `math.pyc`)
Makes all names defined in the `math` module accessible within this module
This module can use those names via `math.` prefix



Standard library

[see slide]

Notes:

`from math import sqrt`

Imports `sqrt` from the `math` module into this module
Can use `sqrt` as if it were defined in this module
Good: No need to specify module name prefixes
Bad: Potential name conflicts
New def overwrites old def

Agenda

- Overview
- Setup
- Simple programs
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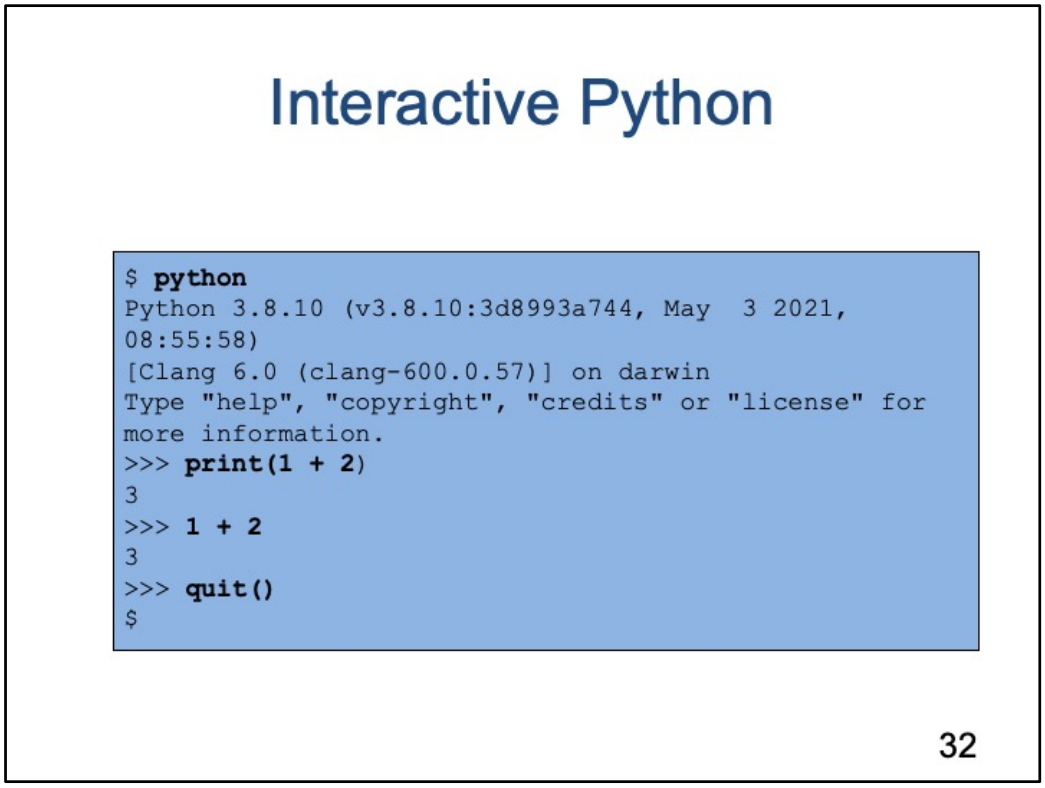
- Functions
- Standard library
- **Interactive Python**



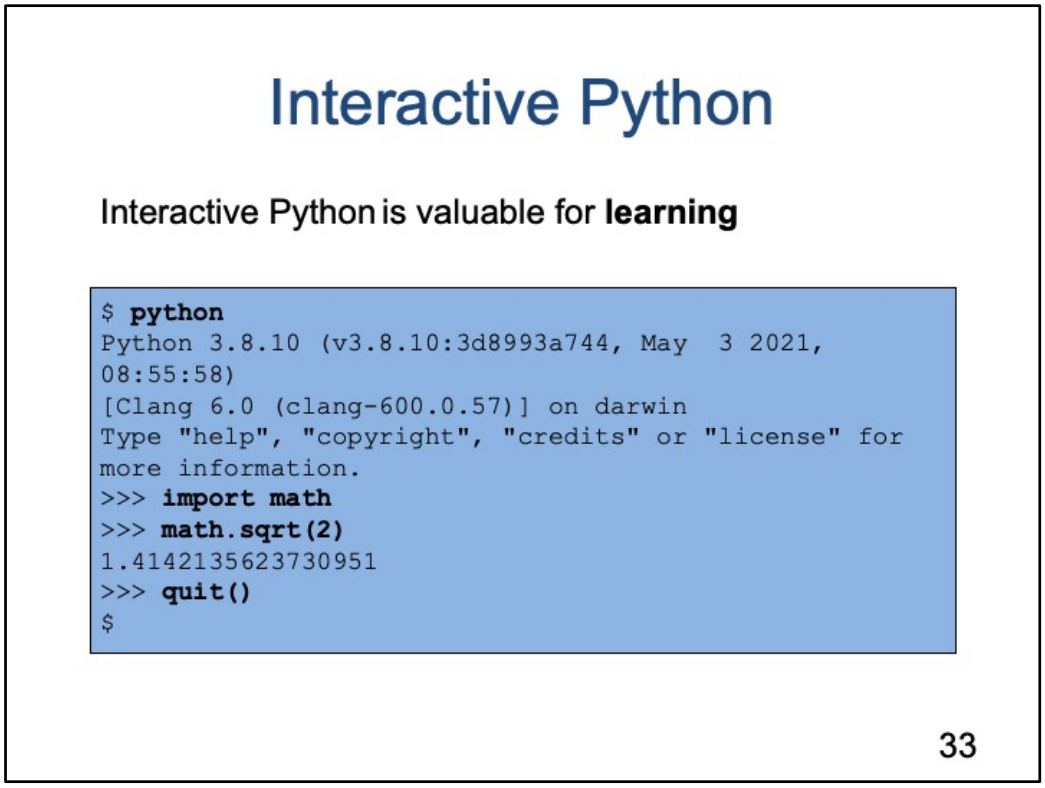
Interactive Python

[see slide]

Issuing a `python` command with no command-line argument runs python in interactive mode

Python writes a >>> prompt

Can call `print()`
    It writes to your terminal
Can enter an expression
    Python evaluates it, and writes the value to your terminal
Calling `quit()` exits python



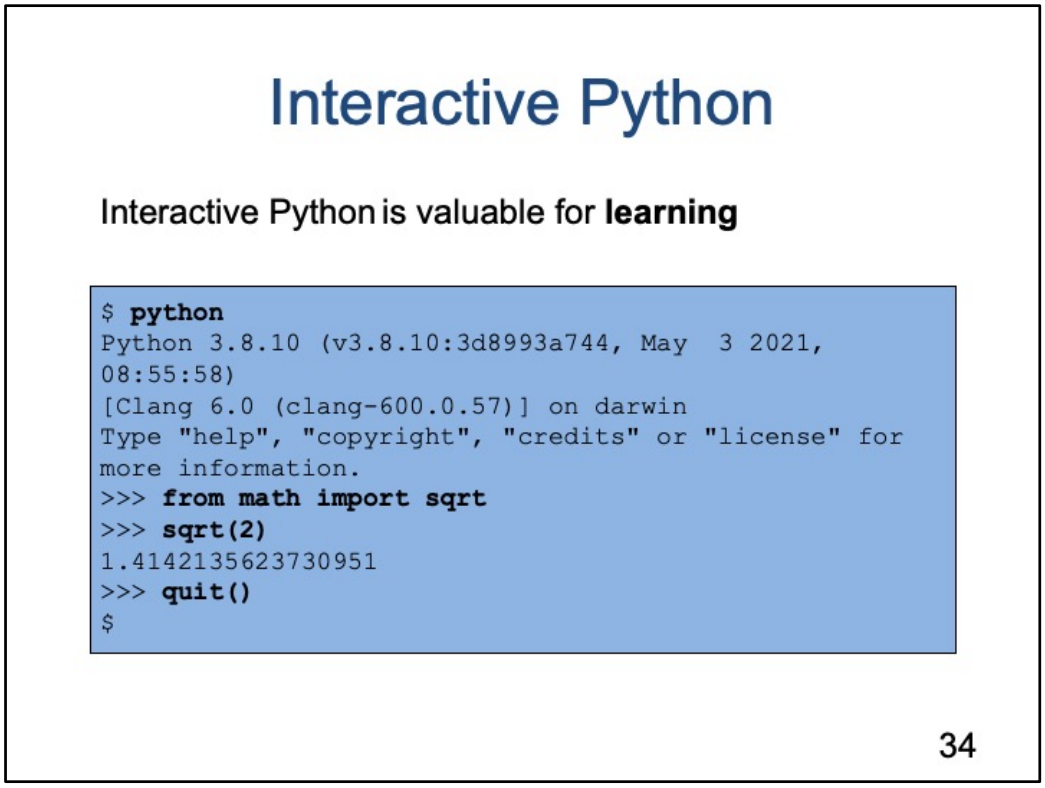
Interactive Python

Interactive Python is valuable for *learning*

Example: Can learn about the `math.sqrt()` function

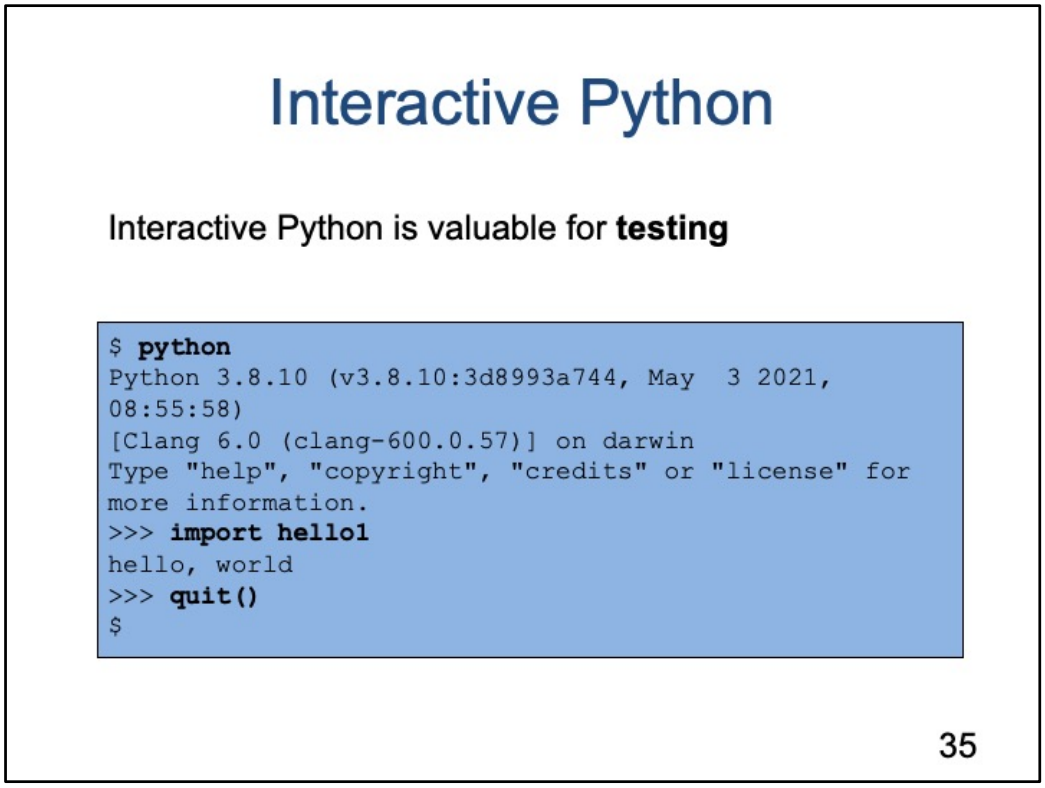
[see slide]

Need not compose a program to call a function
Can call it interactively
(Similar to Java with DrJava or IntelliJ)



Interactive Python

Using from instead of import



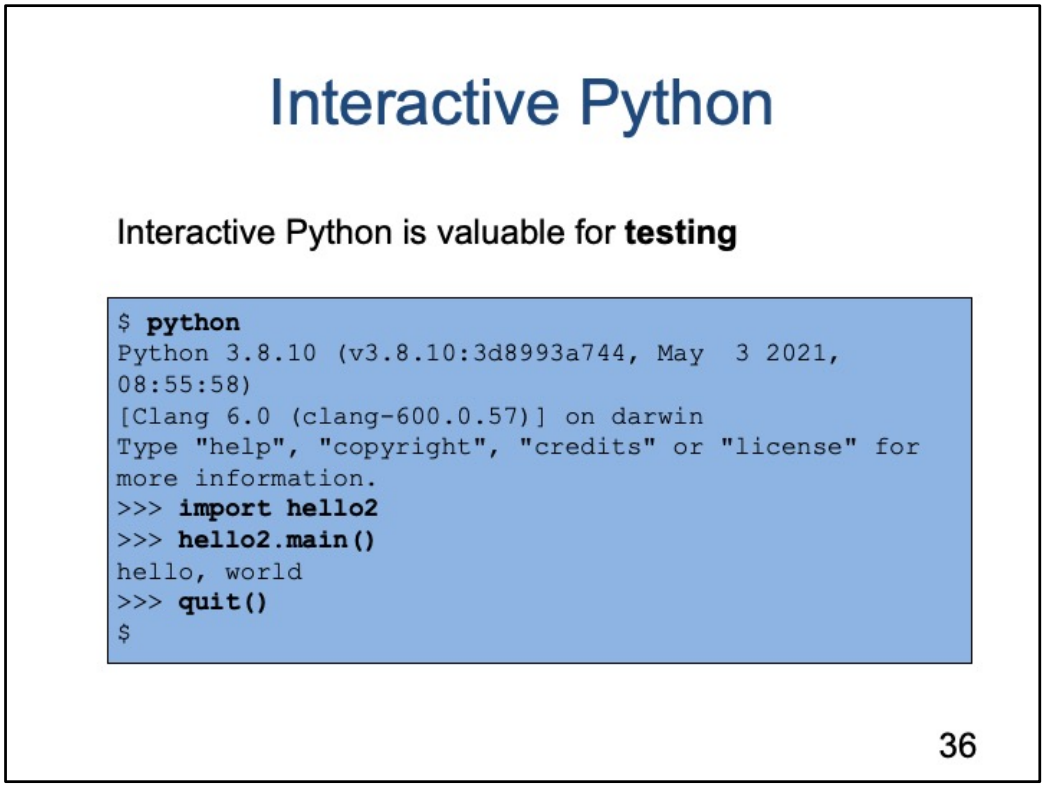
Interactive Python

Interactive Python is valuable for *testing*

[see slide]

Need not compose a program to execute your code
Can execute it interactively
(Similar to Java with DrJava or IntelliJ)

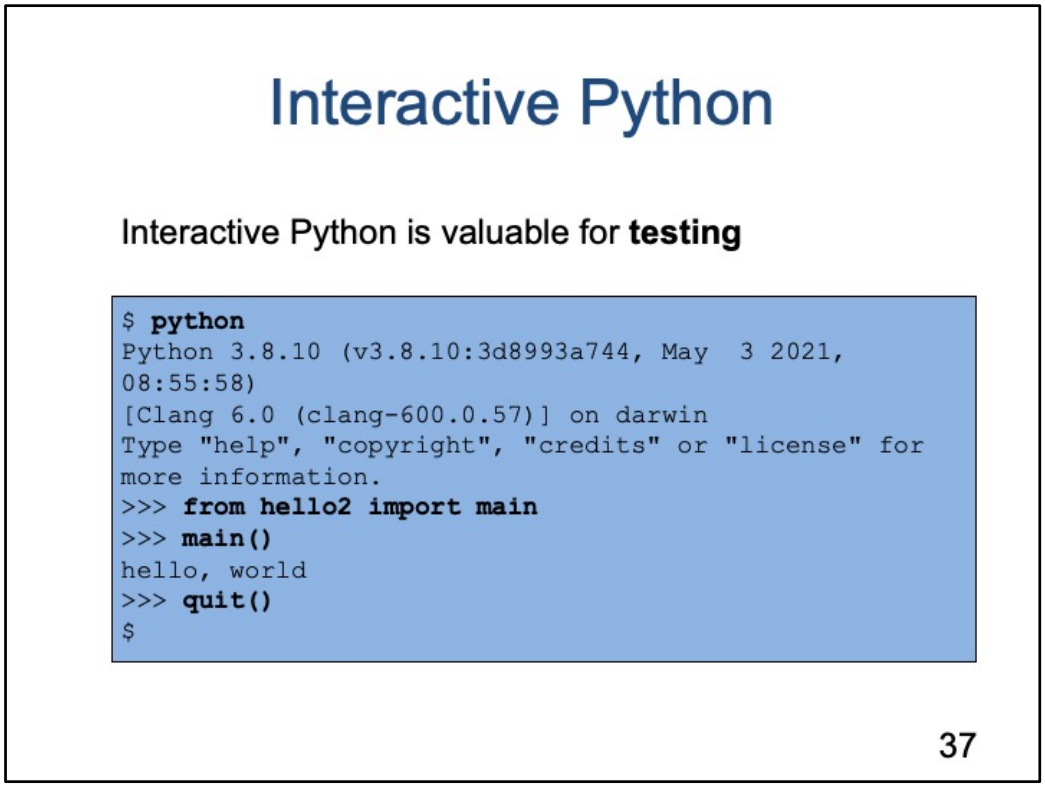
Global code is executed upon import



Interactive Python

[see slide]

It's best to do all computation in function definitions!
Doing so makes your code easier to test



Interactive Python

[see slide]

Using from instead of import

Summary

- We have covered these aspects of Python:
  - Overview
  - Setup
  - Simple programs
  - Building and running
  - Functions
  - Standard library
  - Interactive Python