Welcome to Class

Python for Economics

Morning, Aug 16, 2023

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Course Outline

0. Welcome
1. Introduction
2. Elements of Code
3. Control Structures
4. Data Structures

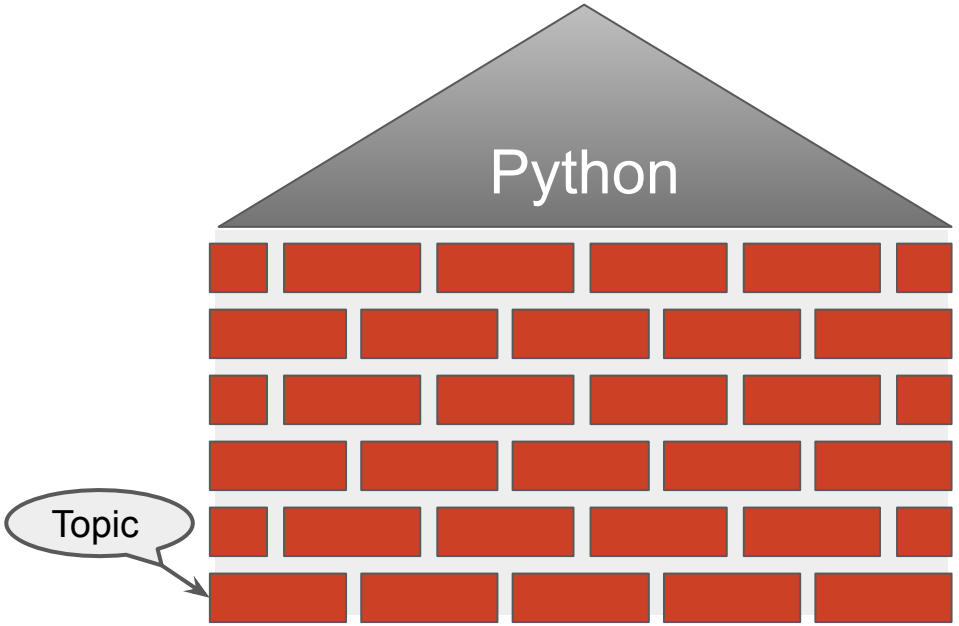
Today

5. Numpy
6. Matplotlib
7. Pandas
8. APIs

Tomorrow

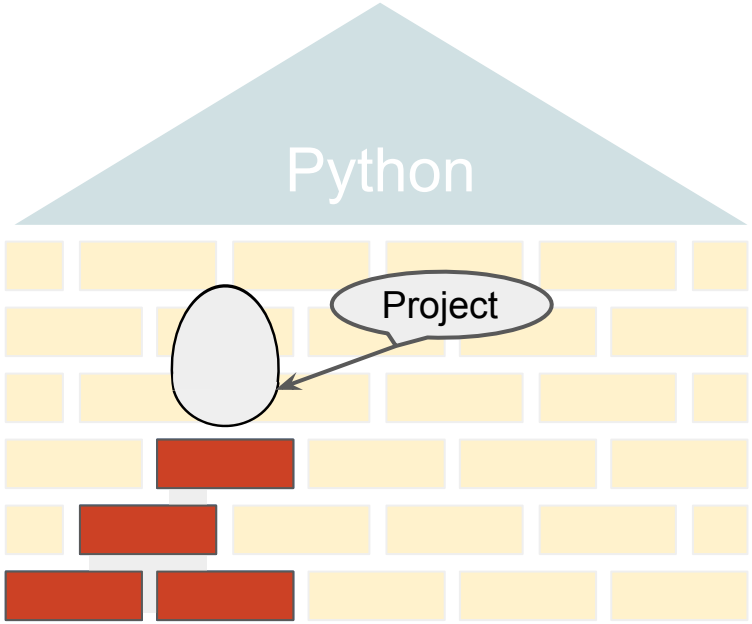
Learn Python

- Python has many topics.
- They build on each other.



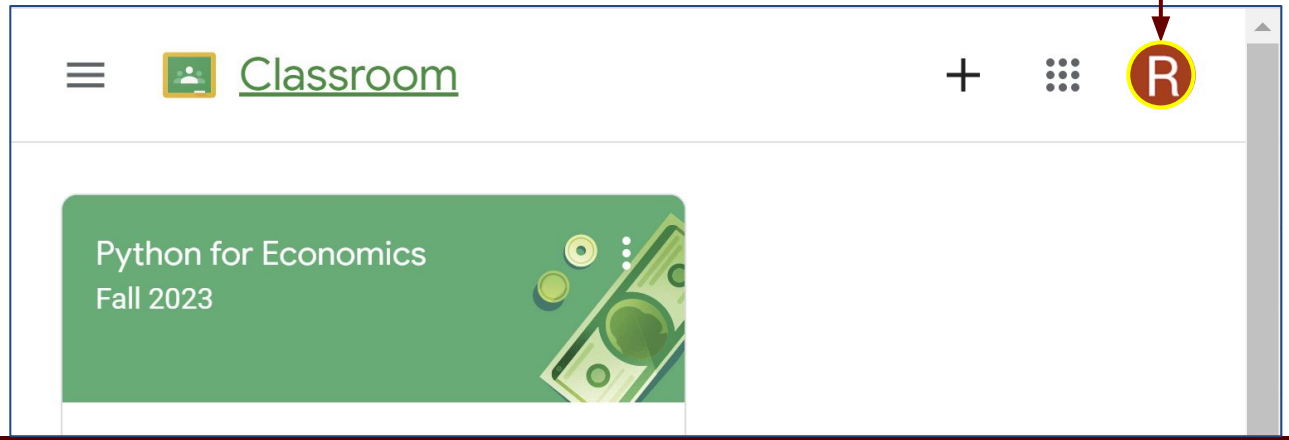
Not all of Python

- A goal of this workshop is to do a project.
- We will learn only a few topics to make that possible.



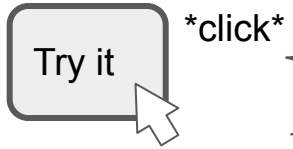
Google Classroom

- Our teaching materials are hosted in a Google Classroom.
- Check your email for an invitation to classroom.google.com
- Log in with your **TAMU Google Account**.



Interactive Learning

- The Jupyter Notebook is a **file** you can edit.
- Colaboratory (provided Free from Google) is the **editor**.
- In a Notebook, you can try out new code right away!



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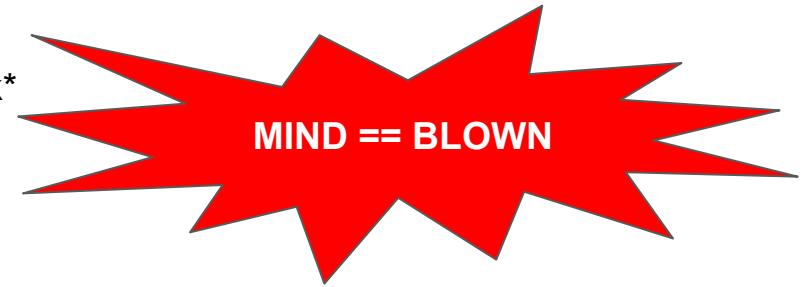
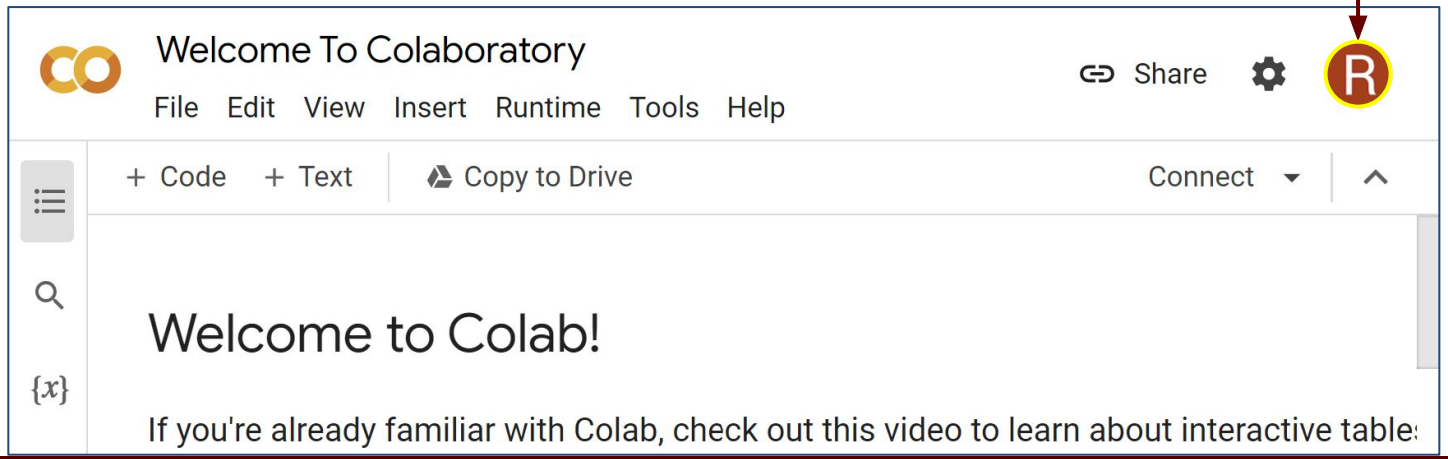


Google Colaboratory

- Please try it now to make sure it works with your browser.
- Navigate to colab.research.google.com
- Log in with your **TAMU Google account**



Introduction to Python

Python for Economics

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Richard Lawrence

What Computers Don't

- Comp
- Comp o what you sa

Disney's *Fantasia* (1940)

Where to get Python

- Windows, Mac, and Linux all have it in their app stores (for free)
- Python is also **online** from Google and others
  - https://colab.research.google.com/
  - https://replit.com/

Note: stay away from Python 2 because Python 3 is much better.

Starting Programming

Let’s get started with:

- Getting familiar with notebooks and Google Colab
- Writing your first Python program

→ Go to notebook to practice

Elements of Code

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Wesley Brashear, Richard Lawrence

This Module

1. Comments
2. Data Types
3. Operators
4. Variables
5. Functions
6. Tuples
7. Multi-line Statements

Some Basics

- Comments:
  Sometimes you need to write stuff that's not executed: annotations, documentation, or code that isn't used.

- Data Types:
  Different kinds of data are treated differently in Python. For example, you can do math with numbers, but you cannot do math with text. Python keeps track of which data "types" you're working with to let you know if you can actually use them together

→ Go to notebook to practice

Break Time Reminder Slide

10 minutes break

Operators: Math and Logic in Python

In Python you will see some of the same symbols you know from math (+, -, <, >, etc) and use them in some of the same ways:

- Integer arithmetic
- Order of operations
- Comparisons
- Logic

...But exactly what they do can depend on the data types involved.

→ Go to notebook to practice

Variables:
The most important concept in programming

Computers are able to store data in memory (a hardware component). This data is stored in the form of binary bits (0s and 1s) and each location in memory has an address which is also in the form of binary bits.

A programming language allows the programmer to refer to the data by a *label* and think abstractly. This is called a *Variable*. It is closely related to the math concept with the same name, but

$$x = 5$$

means something slightly different between math and programming.

→ Go to notebook to practice

Break Time Reminder Slide

10 minutes break

Functions: Reusing Code

- Code in general is predictable, so a program executed more than once will usually result in the same outcome.
- Of course, the results might change if with we start with different *data*, but we very well might want to apply the same *code* to that new data.
- Separation of code and data makes code *reusable*. Reusable code is packaged as “functions”.

→ Go to notebook to practice

Tuples and Multi-line Statements

- Tuples let you work with multiple values at once!
- Parentheses (or brackets or braces) let you split up code over multiple lines.

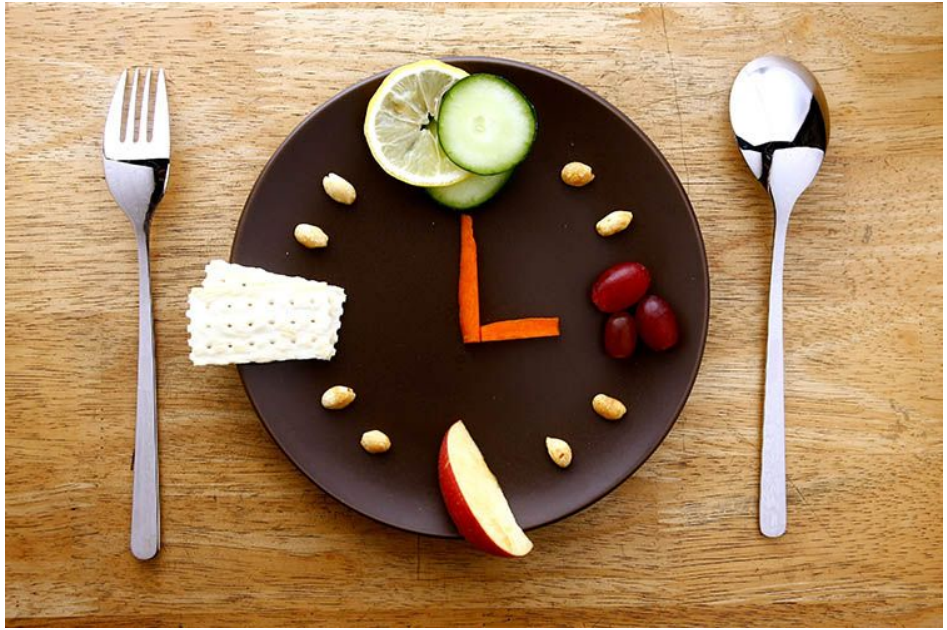
```
a,b,c = 1,2,3
print(" a equals ", a,
      "\n b equals ", b,
      "\n c equals ", c)
```

```
 a equals  1
 b equals  2
 c equals  3
```

→ Go to notebook to practice

Lunch Break Reminder Slide

1 hour break



Control Structures

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Wesley Brashear

This Module

1. Indentation
2. FOR Loops

Indentation: Whitespace

The amount of whitespace at the beginning a line is called the indentation.

```
    statement
```

Other programming languages often ignore whitespace…

But Python does not! Whitespace is important!

Common indentation levels: 2 spaces, 4 spaces, 8 spaces, etc

Warning: *Spaces* and *tabs* are both whitespace, but tabs don't look the same in every text editor so it can be a "gotcha".

Indentation: Blocks

In Python, programs are structured into **blocks**. A block is a group of statements that are executed together.

Statements in a block have the **same** indentation.

```
block 1
block 1
    block 2
    block 2
```

Indentation: Nested Blocks

```
block 1
block 1
    block 2
    block 2
        block 3
    block 2
        block 4
    block 2
block 1
```

Blocks can contain further blocks with greater indentation

Example (left):

- All the statements with no indentation are part of the main block (block 1)
- block 1 contains all the other blocks

Indentation: Nested Blocks

```
block 1
block 1
    block 2
    block 2
        block 3
    block 2
        block 4
    block 2
block 1
```

Blocks can contain further blocks with greater indentation

Example (left):

- **four** lines are part of block 2 because they're separated from each other by statements with *greater* indentation (blocks 3 and 4).

Indentation: Nested Blocks

```
block 1
block 1
    block 2
    block 2
        block 3
    block 2
        block 4
    block 2
block 1
```

Blocks can contain further blocks with greater indentation

Example (left):

- block 3 and block 4 are *different* blocks because they're separated by a statement with *less* indentation (block 2).

Indentation: Control Statements

A block can be executed once, multiple times, or not at all.

A **control statement** determines when, why, and how this occurs.

Control statements *precede* the block and end in a colon ":".

```
block 1
block 1
control statement:
    block 2
    block 2
    control statement:
        block 3
    control statement:
        block 4
    block 2
block 1
```

FOR Loops: Anatomy of a Control Structure

We have already seen the `for` statement. This is an example of a **control structure**.

```
for x in range():
    print()
```

Observations

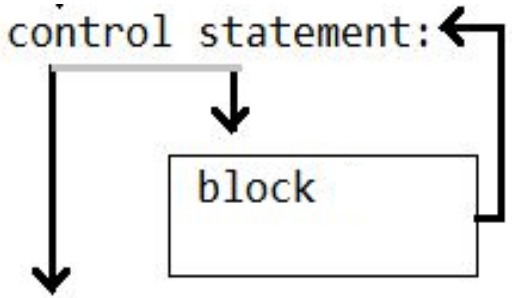
- The `for` **control statement** ends with a colon ":"
- The next line is **indented** (some amount of space on the left)

FOR Loops: Flow Control

The *order* in which statements are executed is called Flow. Control statements determine where flow goes next.

Each control statement can either

- send flow *into* its block
  or
- pass to the statement *after* its block.



When flow reaches the *end* of a block, it returns to the control statement above that block.

FOR loops repeat their block a predetermined number of times.

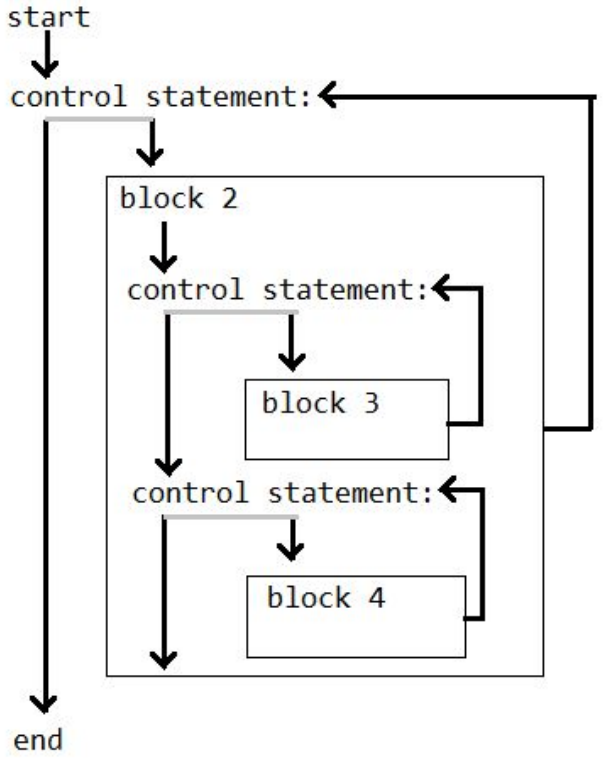
→ Go to notebook to practice

Break Time Reminder Slide

10 minutes break

Nested Flow Control Diagram Example

```
block 1
block 1
control statement:
    block 2
    block 2
    control statement:
        block 3
    control statement:
        block 4
    block 2
block 1
```



Data Structures

Python for Economics

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Josh Winchell

This Module

1. Lists and Dictionaries
2. Index and Key
3. Slicing
4. Methods

The Need for Data Structures

Say we have some data that should all be together–maybe in some order. Creating a bunch of individual variables would be a pain. Let's instead use *data structures*.

```
word1 = "once"
word2 = "upon"
word3 = "a"
word4 = "time"
```

Data structure means applying a label scheme to a group of data elements.

Lists and Dictionaries

A **list** can store multiple values of any type:

```
story = ["Chapter", 1, "Once", "upon", "a","time"]
print(story)
```

```
['Chapter', 1, 'Once', 'upon', 'a', 'time']
```

A **dictionary** stores values (again of any type) with specified "keys":

```
story = {
    "Title": "Snow White",
    "Chapter": 1,
    "Text": "Once upon a time"
    }
print(story)
```

```
{'Title': 'Snow White', 'Chapter': 1, 'Text': 'Once upon a time'}
```

→ Go to notebook to practice

Index and Key

Once we have data inside our data structures, we need to be able to access specific pieces of it:

- Lists and strings have an index (integers, starting at 0):

  ```
  story[0]=”Once”
  ```

- Dictionaries have *keys* (multiple possible data types).

  ```
  story[“first”]=”Once”
  ```

→ Go to notebook to practice

Break Time Reminder Slide

10 minutes break

Slicing

We may want to get a *range* of values from a string or list:

```
my_string = "eenie meenie minie moe"
print(my_string[6:18])

my_list = ["eenie", "meenie", "minie", "moe"]
print(my_list[1:3])
```

```
meenie minie
['meenie', 'minie']
```

→ Go to notebook to practice

Methods

Data structures (and other things) have their own built-in functions called *methods:*

```
my_list = ["gizmo","whatchamacallit","doodad","thingamajig","maguffin"]
my_list.sort()
print(my_list)
```

```
['doodad', 'gizmo', 'maguffin', 'thingamajig', 'whatchamacallit']
```

→ Go to notebook to practice

End of Day!

Let us know if you have questions