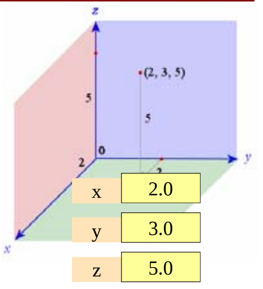
Lecture 7 Announcements

- Please check the ***end*** of the Lecture 6 slides (slides 25-29) for many announcements:
  http://www.cs.cornell.edu/courses/cs1110/2017sp/lectures/02-14-17/presentation-06.pdf
- Incorrect link for how to break up long lines in Section 10 of Assignment 1. Watch course website for announcements about A1:
  http://www.cs.cornell.edu/courses/cs1110/2017sp/announcements.php

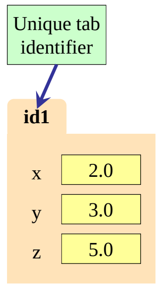
Type: Set of values and the operations on them

- Want a point in 3D space
  - We need three variables
  - *x*, *y*, *z* coordinates
- What if have a lot of points?
  - Vars x0, y0, z0 for first point
  - Vars x1, y1, z1 for next point
  - …
  - This can get really messy
- How about a single variable that represents a point?



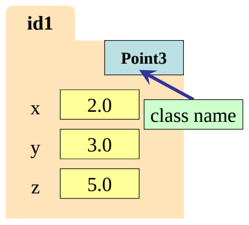
Objects: Organizing Data in Folders

- An object is like a **manila folder**
- It contains other variables
  - Variables are called **attributes**
  - These values can change
- It has an **ID** that identifies it
  - Unique number assigned by Python (just like a NetID for a Cornellian)
  - Cannot ever change
  - Has no meaning; only identifies



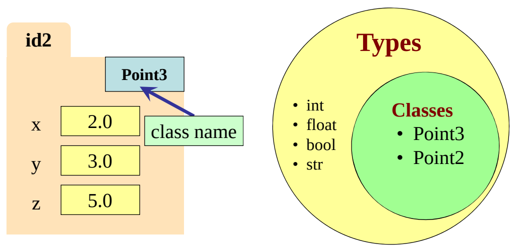
Classes: Types for Objects

- Values must have a type
  - An object is a **value**
  - Object type is a **class**
- **Modules** provide classes
  - Will show how later
- **Example**: geom
  - Classes: Point2, Point3



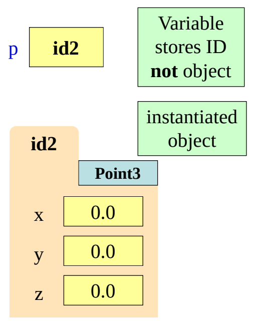
Classes: Types for Objects

- Classes are how we add new types to Python



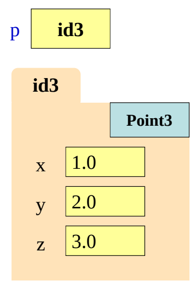
Constructor: Function to make Objects

- How do we create objects?
- **Constructor Function**:
  - Same name as the class
  - **Example**: Point3(0,0,0)
  - Makes an object (manila folder)
  - Returns folder ID as value
- **Example**: p = Point3(0, 0, 0)
  - Creates a Point object
  - Stores object's ID in p
  - You *need* the assignment to p to be able to use the object later



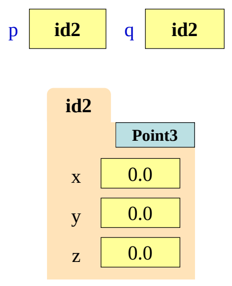
Accessing Attributes

- Attributes are variables that live inside of objects
  - Can **use** in expressions
  - Can **assign** values to them
- **Access**: <variable>.<attr>
  - **Example**: p.x
  - Look like module variables
- Putting it all together
  - p = geom.Point3(1,2,3)
  - p.x = p.y + p.z



Object Variables

- Variable stores object name
  - **Reference** to the object
  - Reason for folder analogy
- Assignment uses object contents
  - **Example**: q = p
  - Takes contents from p
  - Puts the contents in q
  - Does not make new folder!
- This is the cause of many mistakes in this course



Exercise: Attribute Assignment

- Recall, q gets name in p

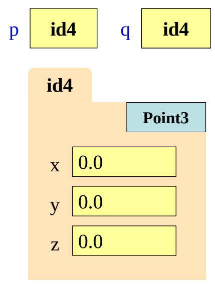
```
>>> p = geom.Point3(0,0,0)
>>> q = p
```

- Execute the assignments:

```
>>> p.x = 5.6
>>> q.x = 7.4
```

- What is value of p.x?

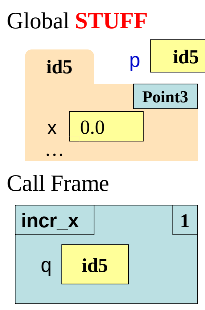
A: 5.6
B: 7.4
C: **id4**
D: I don't know



Call Frames and Objects

- Mutable objects can be altered in a function call
  - Object vars hold names!
  - Folder accessed by both global var & parameter
- **Example**:

```
def incr_x(q):
1    q.x = q.x + 1
>>> p = geom.Point3()
>>> incr_x(p)
```


Global STUFF
id5
p
id5
Point3
x
0.0
…
Call Frame
incr_x
1
q
id5