Object-Oriented Programming (OOP)

Announcements

- Quiz 03 will be returned today!
- LS11 (Intro to OOP) due today
- EX04 due today
- RD00 (reading responses) due Wednesday

What are objects *in the real world*?

Things that can be perceived, used, or interacted with

They can be *physical*:

- Chair is a type of furniture
- Human is a type of mammal
- Fork is a type of utensil

or *abstract*:

- Happiness is a type of emotion
- Friendship is a type of relationship
- Learning is a type of experience

And they all serve distinct purposes!

What are objects *in Python*?

Many types of data in Python:

```
23      "hello world!"        3.14159        [24, 26, 25, 27]

{110.001: "Lytle and Jordan", 110.003: "Hinks"}       True
```

Every object has:

- A type
- An internal data representation
- A set of procedures for interaction with the object

An object is an instance of a type

- `23` is an instance of an `int`
- `"hello world!"` is an instance of a `str`

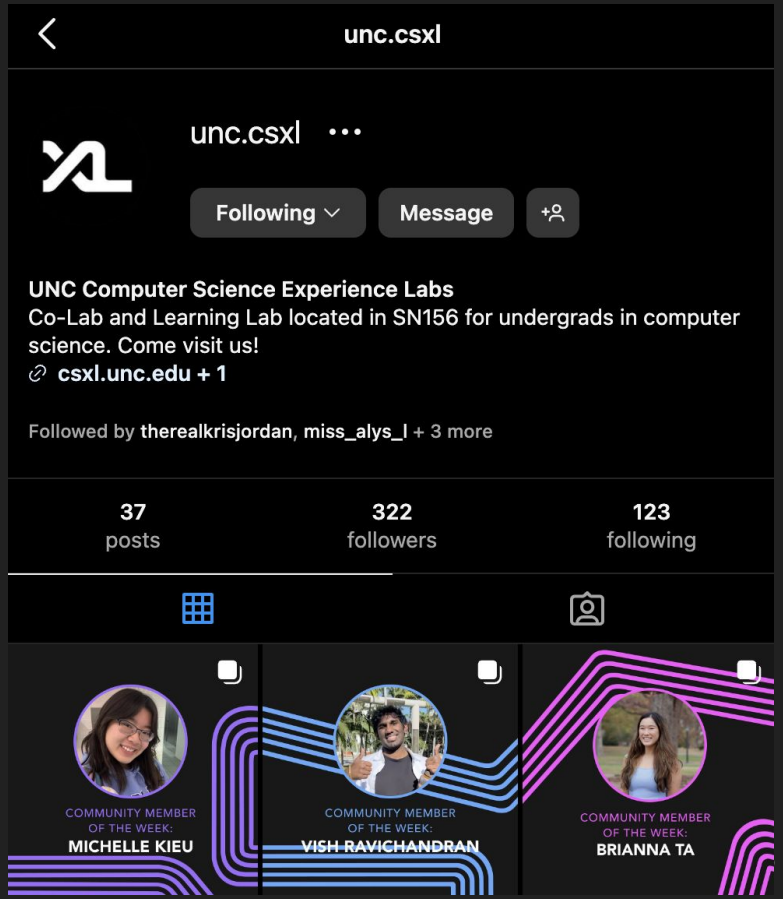
Modeling an Instagram profile with code

What data should we keep track of?

```
username: str = "unc.csxl"
bio: str = "UNC CS Experience Labs"
posts: int = 37
followers: int = 322
following: int = 123
private: bool = False
```

What behaviors would be useful?

- View # followers or following
- Write or update a bio
- (Un)follow an account
- Make an account private/public



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Instagram has over **2 billion** user profiles…

What challenges could we encounter?

It’d be nice to be able to bundle these attributes and functions into one object per profile…

Modeling an Instagram profile with a `class`

declaring a new data type!

```
class Profile:
```

Modeling an Instagram profile with a `class`

declaring a new data type!

```
class Profile:
    username: str
    bio: str
    followers: int
    following: int
    private: bool
```

declaring attributes
(every Instagram profile has these!)

Modeling an Instagram profile with a `class`

declaring a new data type!

```
class Profile:
    username: str
    bio: str
    followers: int
    following: int
    private: bool

    def __init__(self):
        self.username = "usr9"
        self.bio = ""
        self.followers = 0
        self.following = 0
        self.private = False
```

declaring attributes
(every Instagram profile has these!)

initializing attributes
(what are the default values?)

Modeling an Instagram profile with a `class`

declaring a new data type!

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my_prof: Profile = Profile()
```

declaring attributes
(every Instagram profile has these!)

initializing attributes
(what are the default values?)

Construct (instantiate) a new profile!

Modeling an Instagram profile with a `class`

declaring a new data type!

```
class Profile:
    username: str
    bio: str
    followers: int
    following: int
    private: bool

    def __init__(self):
        self.username = "usr9"
        self.bio = ""
        self.followers = 0
        self.following = 0
        self.private = False

my_prof: Profile = Profile()
my_prof.username = "comp110fan"
print(my_prof.private)
```

declaring attributes
(every Instagram profile has these!)

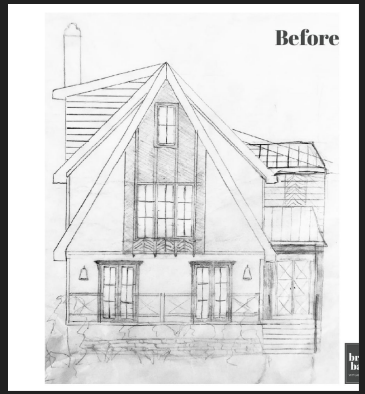
initializing attributes
(what are the default values?)

Memory diagram

```
1 class Profile:
2    username: str
3    bio: str
4    followers: int
5    following: int
6    private: bool
7
8    def __init__(self):
9        self.username = ""
10       self.bio = ""
11       self.followers = 0
12       self.following = 0
13       self.private = False
14
15
16 my_prof: Profile = Profile()
17 your_prof: Profile = Profile()
18 your_prof.username = "unccompsci"
19 my_prof.username = "unc.csxl"
20
21 print(my_prof.username)
```

Review of **classes** and **objects**

- Think of a **class** as a blueprint/ template
  - Defines attributes and behaviors its objects will have
- An **object** is an *instance* of a class
  - E.g., if the class is the blueprint, the object is the house!
  - Has all the specified attributes and behaviors
  - Different objects share these attributes and behaviors, but are distinct!



Returning to our goal: modeling an Instagram profile with code

What data should we keep track of?

```
username: str = "unc.csxl"
bio: str = "UNC CS Experience Labs"
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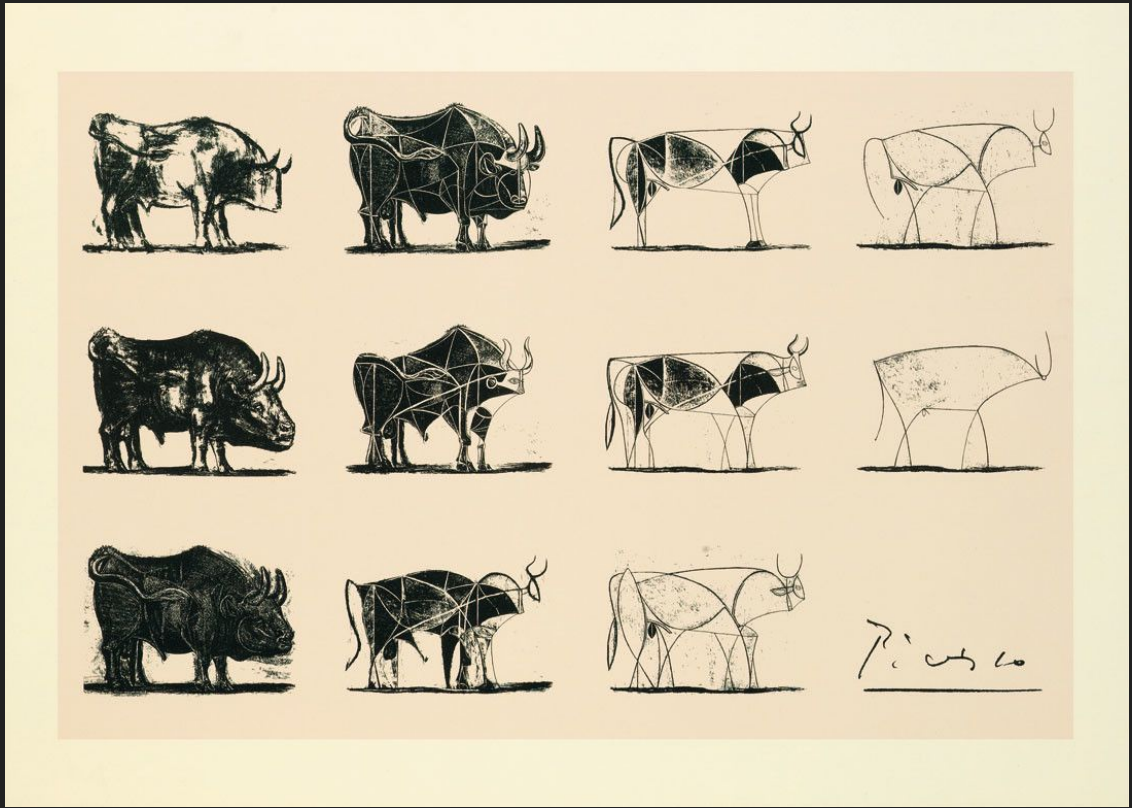
```

What behaviors would be useful?

- View # followers or following
- Write or update a bio
- (Un)follow an account
- Make an account private/public

How can we write code to enable these actions for any Instagram account?

What does Picasso's "Bull" progression show?



Pablo Picasso. Bull (1945). A Lithographic Progression.

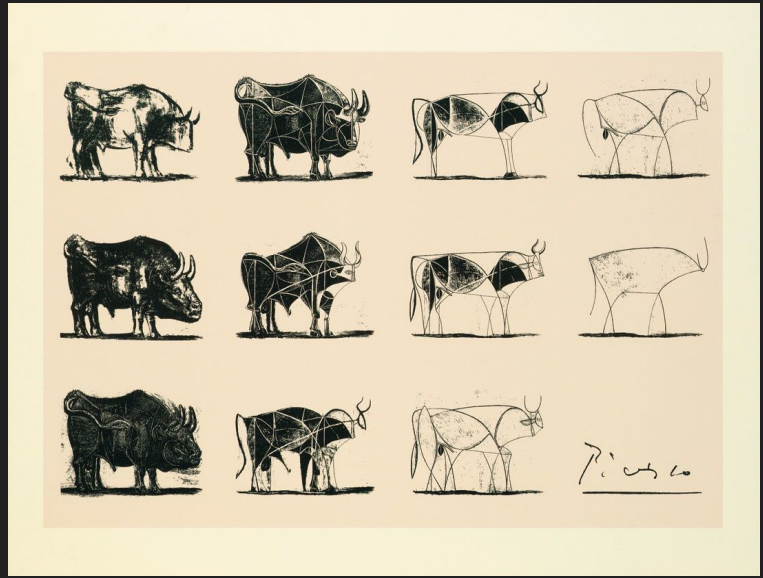
Abstraction: whittling down to the essentials

Real-world example: Flights

What information do you need when you're preparing for (or actively on) a flight?

- ALL of the flight details?
  - E.g., how the pilot flies the plane

  or,
- Only the ones that are essential for you to know?
  - Departure and arrival times/cities, your seat assignment, plans after landing



Pablo Picasso. Bull (1945). A Lithographic Progression.

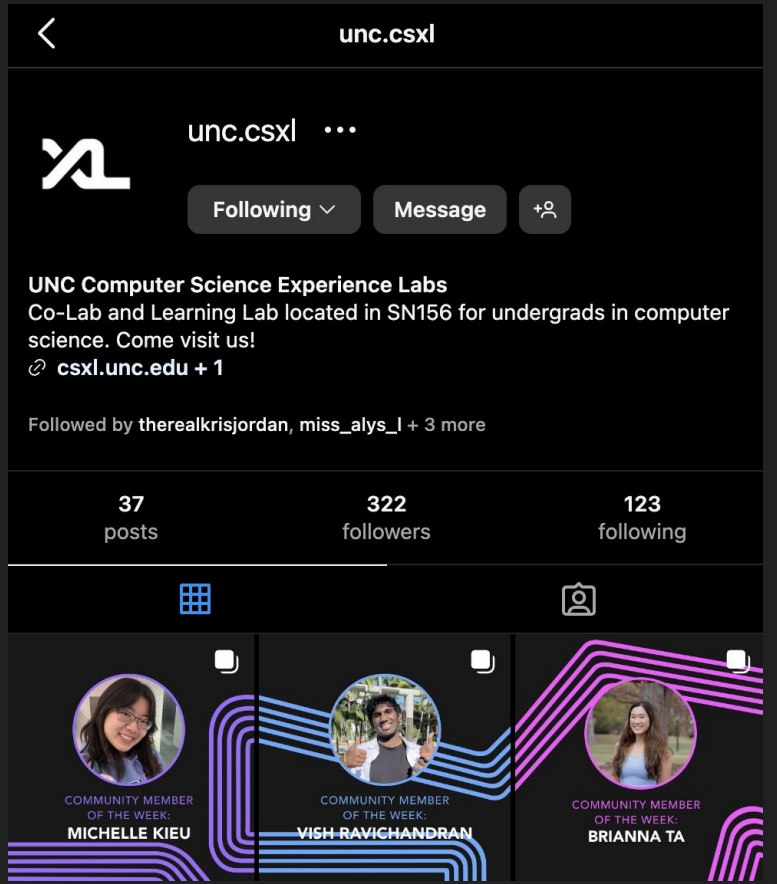
Abstraction: whittling down to the essentials

Today's example: Instagram Profiles

When you:

- ❑ Follow someone
- ❑ Make your account private
- ❑ Post a new photo

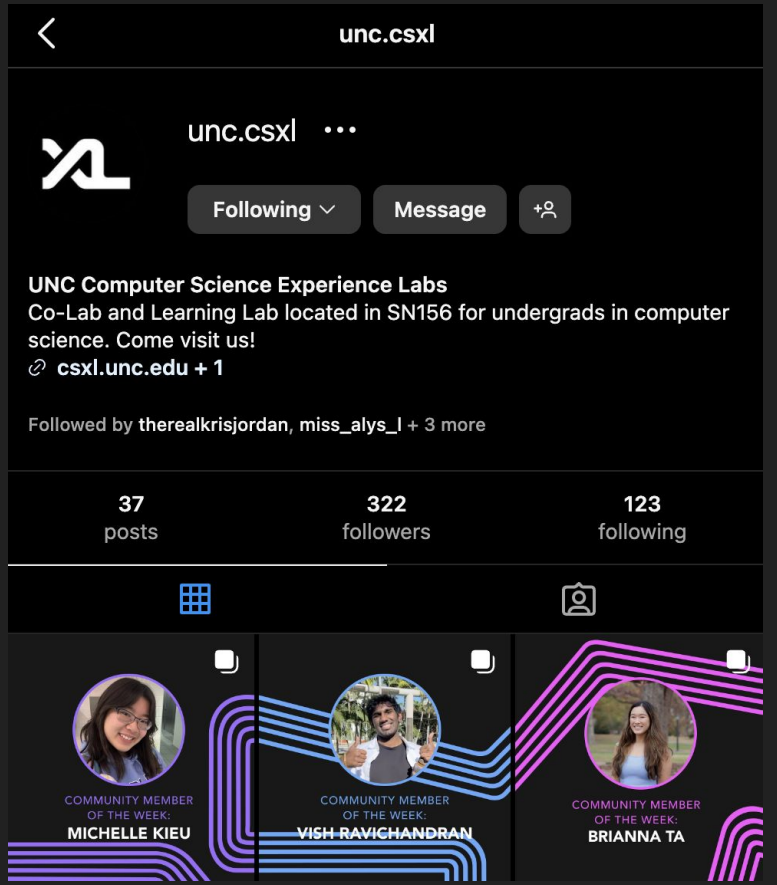
Do you think about what's happening behind the scenes (in Meta's code)?



Objects are a **data abstraction**

All objects have:

1. An **internal representation**
   a. Data attributes
2. An **interface** for interacting with the object
   a. Interface defines behaviors but *hides implementation* (the details!)
   b. **Methods**: Functions defined within a class
      i. `self` is the first parameter



Methods: defined in the *class*, called on *objects*

```
1  class Profile:
2      username: str
3      followers: list[str]
4      following: list[str]
5
6      def __init__(self, handle: str):
7          self.username = handle
8          self.followers = []
9          self.following = []
10
11     # Method definitions
12     def follow(self, username: str) -> None:
13         self.following.append(username)
14
15     def following_count(self) -> int:
16         return len(self.following)
17
18 my_prof: Profile = Profile("comp110fan")  # Calls __init__()
19
20 my_prof.follow("unc.latinosintech")
21 print(my_prof.following_count())
```

Method definitions
(first parameter is `self`)!

Method call
<object>.<method>(<non-`self` arguments>)

Memory diagram

```
1  class Profile:
2      username: str
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21 print(my_prof.following_count())
```

Code writing

```
1   class Point:
2       x: float
3       y: float
4
5       def __init__(self, x: float, y: float):
6           self.x = x
7           self.y = y
8
9       def dist_from_origin(self) -> float:
10          return (self.x**2 + self.y**2) ** 0.5
11
12      def translate_x(self, dx: float) -> None:
13          self.x += dx
14
15
16  p0: Point = Point(10.0, 0.0)
17  p0.translate_x(-5.0)
18  print(p0.dist_from_origin())
```

Following line 18, write additional lines of code that:

1. Declares an additional variable of type `Point` and initializes it to a new `Point` object with coordinates `(1.0, 2.0)`
2. Call the `translate_x` method on your `Point` object, passing an argument of `1.0`.
3. Print the value returned by calling the `dist_from_origin` method on your `Point` object.

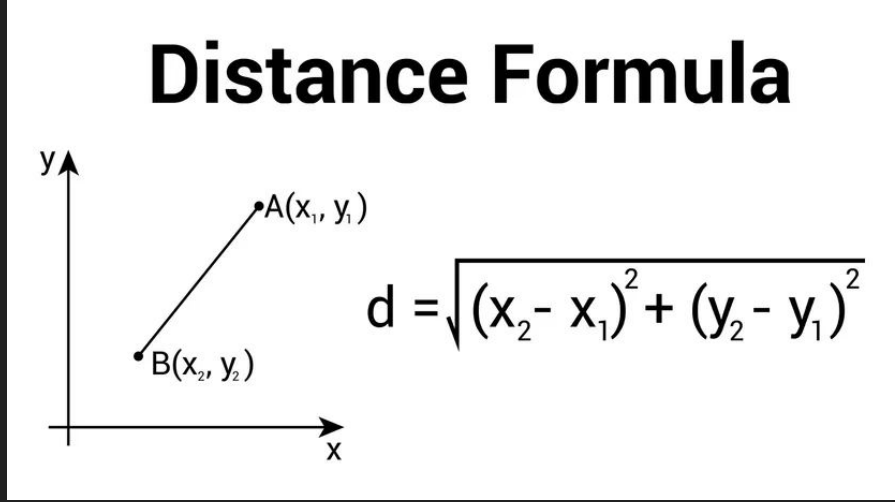
What would the printed output be?
(This is great additional practice to try diagramming!)

Want more practice?

Memory Diagram

```python
class Point:
    x: float
    y: float

    def __init__(self, x: float, y: float):
        self.x = x
        self.y = y

    def dist_from_origin(self) -> float:
        return (self.x**2 + self.y**2) ** 0.5

    def translate_x(self, dx: float) -> None:
        self.x += dx


p0: Point = Point(10.0, 0.0)
p0.translate_x(-5.0)
print(p0.dist_from_origin())
```

Class and method writing



- Write a class called `Coordinate`
- It should have two attributes:
  - `x: float` and `y: float`
- Write a `constructor` that takes three parameters:
  - `self`, `x (float)` and `y (float)`
- Write a method called `get_dist` that takes as parameters `self` and `other` (another `Coordinate` object). The method should return the distance between the two `Coordinate` objects (use the equation above!).