CSCI 127: Joy and Beauty of Data

Lecture 13: OOP

Reese Pearsall

Summer 2021

https://reesep.github.io/classes/summer2021/127/main.html

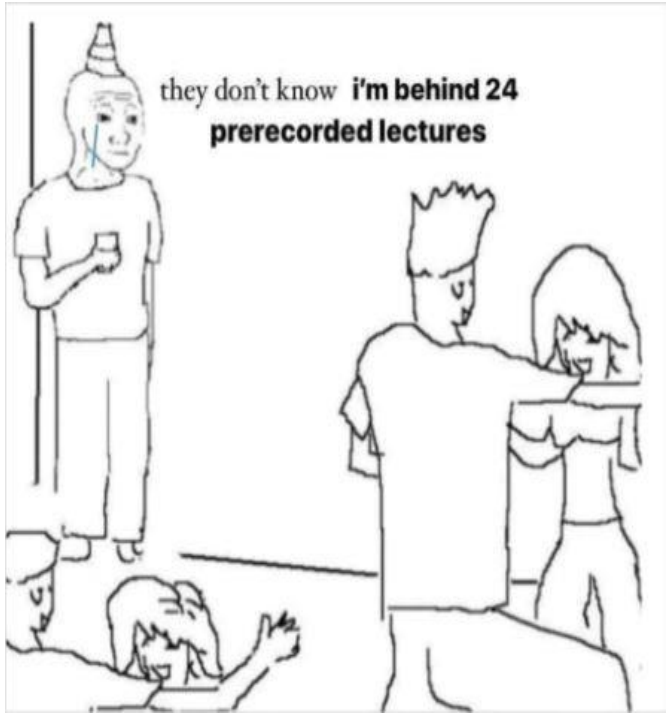
Announcements

Program 3 due **tonight** @ 11:59 PM

Lab 7 (Dictionaries) due **tomorrow** @ 11:59 PM

Lab 8 due on **Thursday** @ 11:59 P.M.
- After today, you will be able to finish it

Program 4 due on **Sunday** 6/13 @ 11:59 PM
- After today, you will be able to finish it



Everyone is eligible for full access to PyCharm!

FYI: You can use late passes on any remaining lab/program

If you have not signed up for a 1 on 1 meeting time with me yet, **make sure to do that sometime this week**

Me if I have to take off 5% of your final because you never signed up for a time to meet with me

Object Oriented Programming

So far, we have used **procedural programming** to solve problems. We have written **functions** that do things

Now, we will talk about a different way to solve problems…

Object Oriented Programming (OOP) is a paradigm of solving problems using objects, which represent *something*

The objects we create usually have data (**states/attributes**) and behaviors (**methods**)

Object Oriented Programming Example

There are many different kinds of cars…

Images stolen from the internet

Object Oriented Programming Example

There are many different kinds of cars…

However, all cars share similar features

Images stolen from the internet

Object Oriented Programming Example

There are many different kinds of cars…

However, all cars share similar features

All cars have:

- A color
- Wheels
- Engine
- Windshield
- Windows
- Seating
- Lights

Images stolen from the internet

Object Oriented Programming Example

There are many different kinds of cars…

However, all cars share similar features

All cars have:

- A color
- Wheels
- Engine
- Windshield
- Windows
- Seating
- Lights

All cars can:

- Accelerate
- Slow down
- Stop
- Turn

Object Oriented Programming Example

There are many different kinds of cars…

However, all cars share similar features

All cars have:

- A color
- Wheels
- Engine
- Windshield
- Windows
- Seating
- Lights

Attributes

All cars can:

- Accelerate
- Slow down
- Stop
- Turn

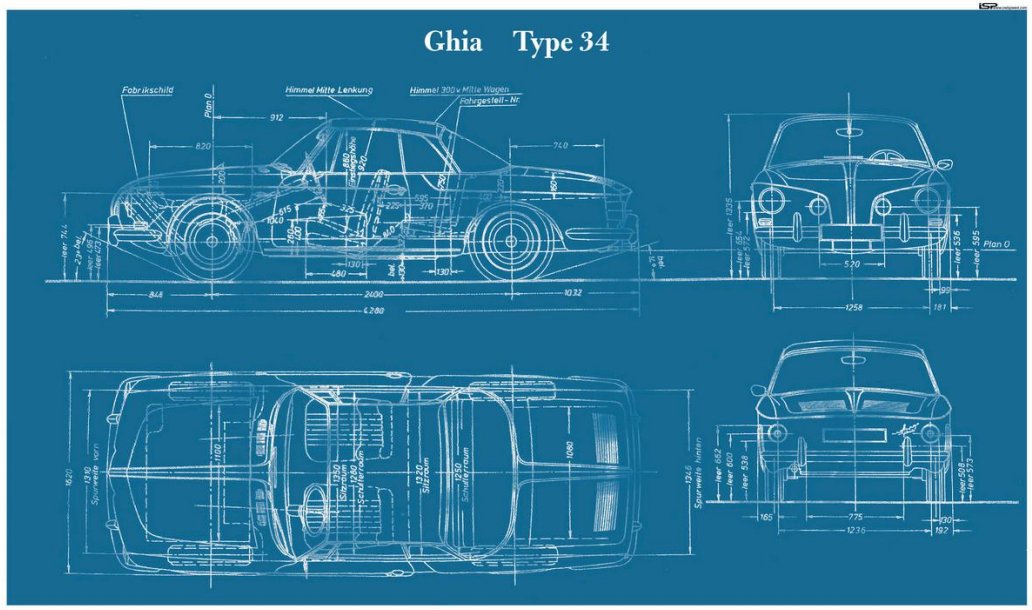
Functionality/Behavior

Object Oriented Programming Example

If we can create a **blueprint** for a generic car, then we can use that blueprint to create many different cars

When we create a car using that blue print, we can specify the different **attributes** (color, # of seats, speed, etc)

When we create a car, we give the car access to different kinds of **behavior** (accelerating, stopping, turning, etc)

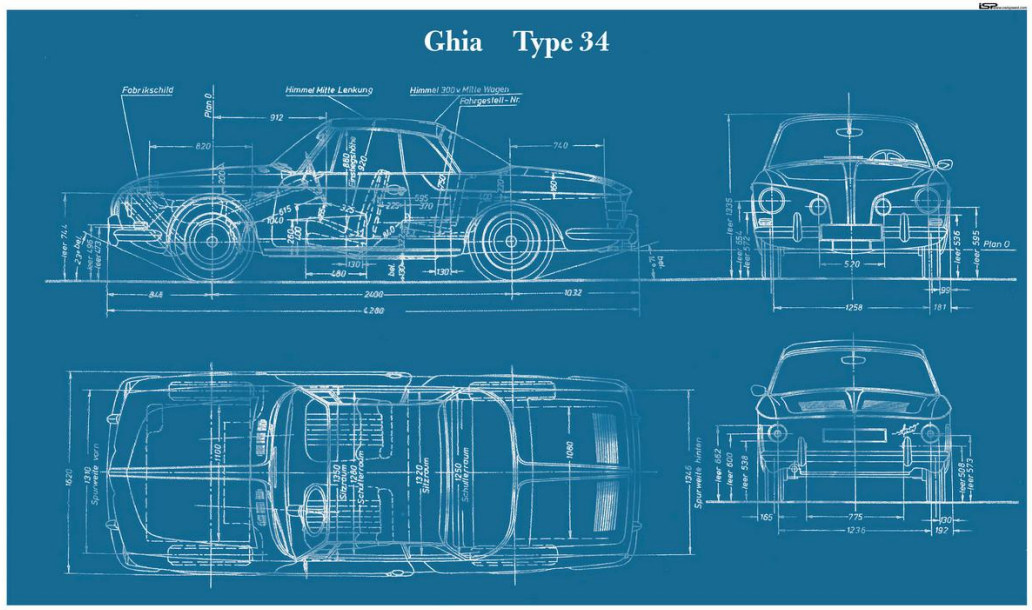


Object Oriented Programming Example

If we can create a ~~**blueprint**~~ class for a generic car, then we can use that ~~blueprint~~ class to create many different cars

When we create a car using that blue print, we can specify the different **attributes** (color, # of seats, speed, etc)

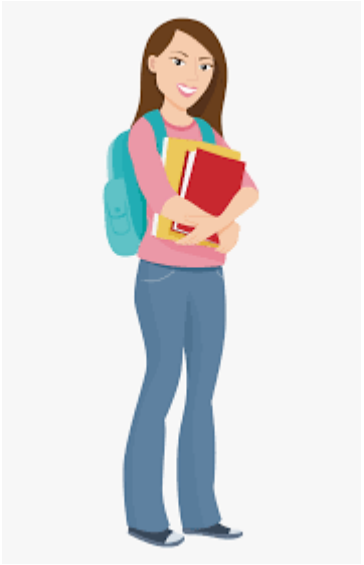
When we create a car, we give the car access to different kinds of **behavior** (accelerating, stopping, turning, etc)



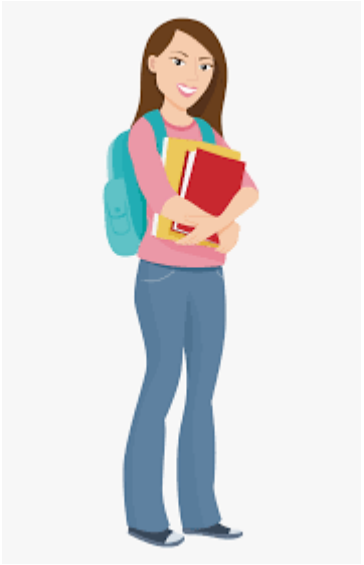
Student Example

Consider a college student at MSU…

What sort of attributes may a college student have?



Student Example



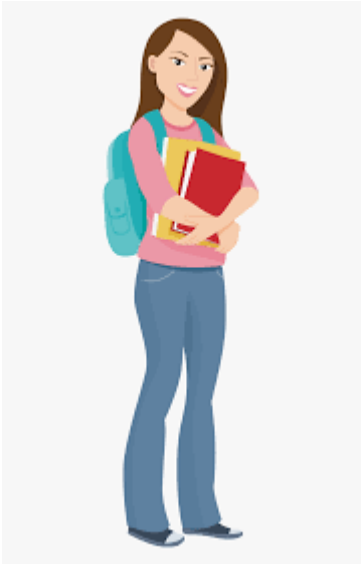
Consider a college student at MSU…

What sort of attributes may a college student have?

- Name
- Major
- GPA
- Student ID Number
- Year (freshman, sophomore, junior, senior)

And much more ….

Student Example



Consider a college student at MSU…

What sort of attributes may a college student have?

- Name
- Major
- GPA
- Student ID Number
- Year (freshman, sophomore, junior, senior)

And much more ….

Lets create our blueprint!

OOP in Python

Define classes using the **`class`** keyword

- All class names should be capitalized

All classes need a constructor. A constructor is the method that will create the object

- Constructor will **always** be:

```
def __init__(<insert parameters here>):
```

All methods need to go inside of the class

Reader methods: getName(), getMajor(), etc

Writer methods: setName(), setMajor(), etc

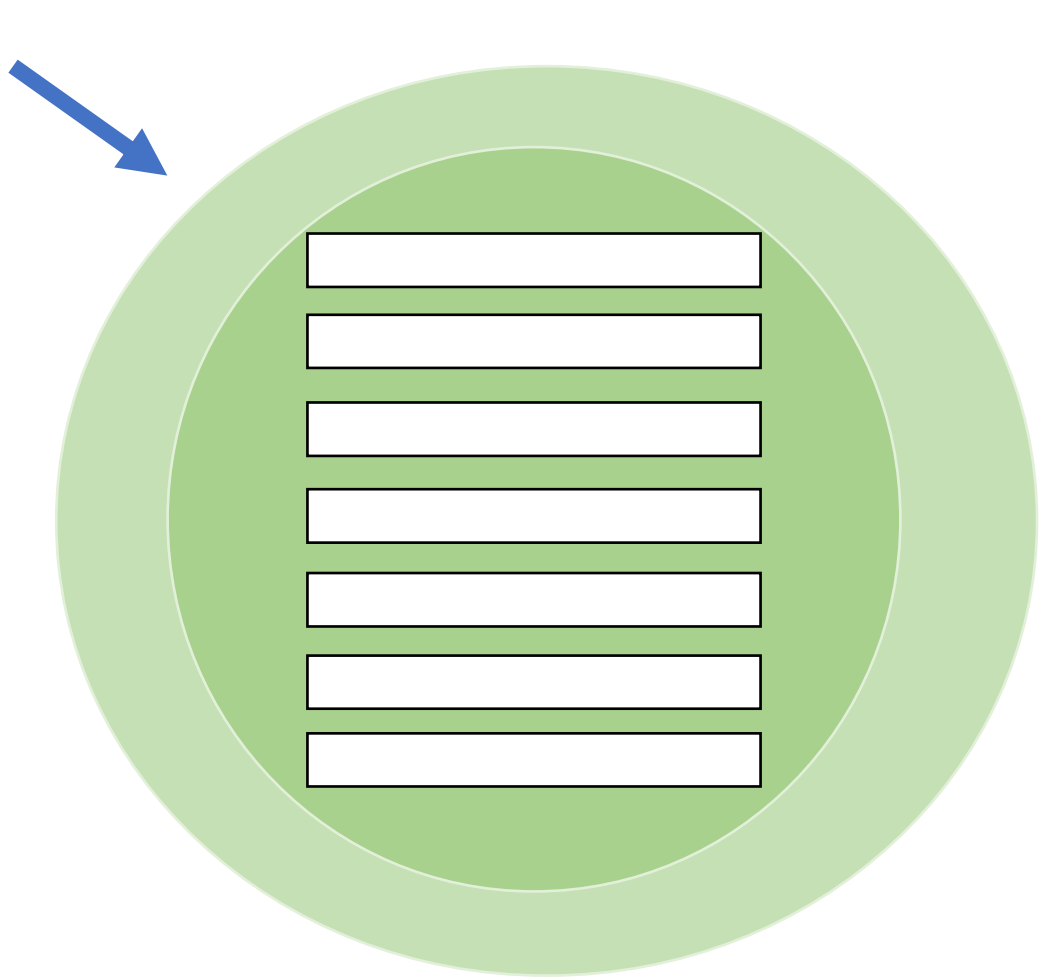
OOP Review

We create and use objects using **classes**

```
student1 = Student("James","Computer Science","04293401",4.0,"Junior")
```

We start off in our **constructor**

```
def __init__(self,name,major,student_id,gpa="Undefined",year="Freshman"):
    self.name = name
    self.major = major
    self.student_id = student_id
    self.gpa = gpa
    self.year = year
    self.champ_change = 0
    self.minor = "N/A"
```



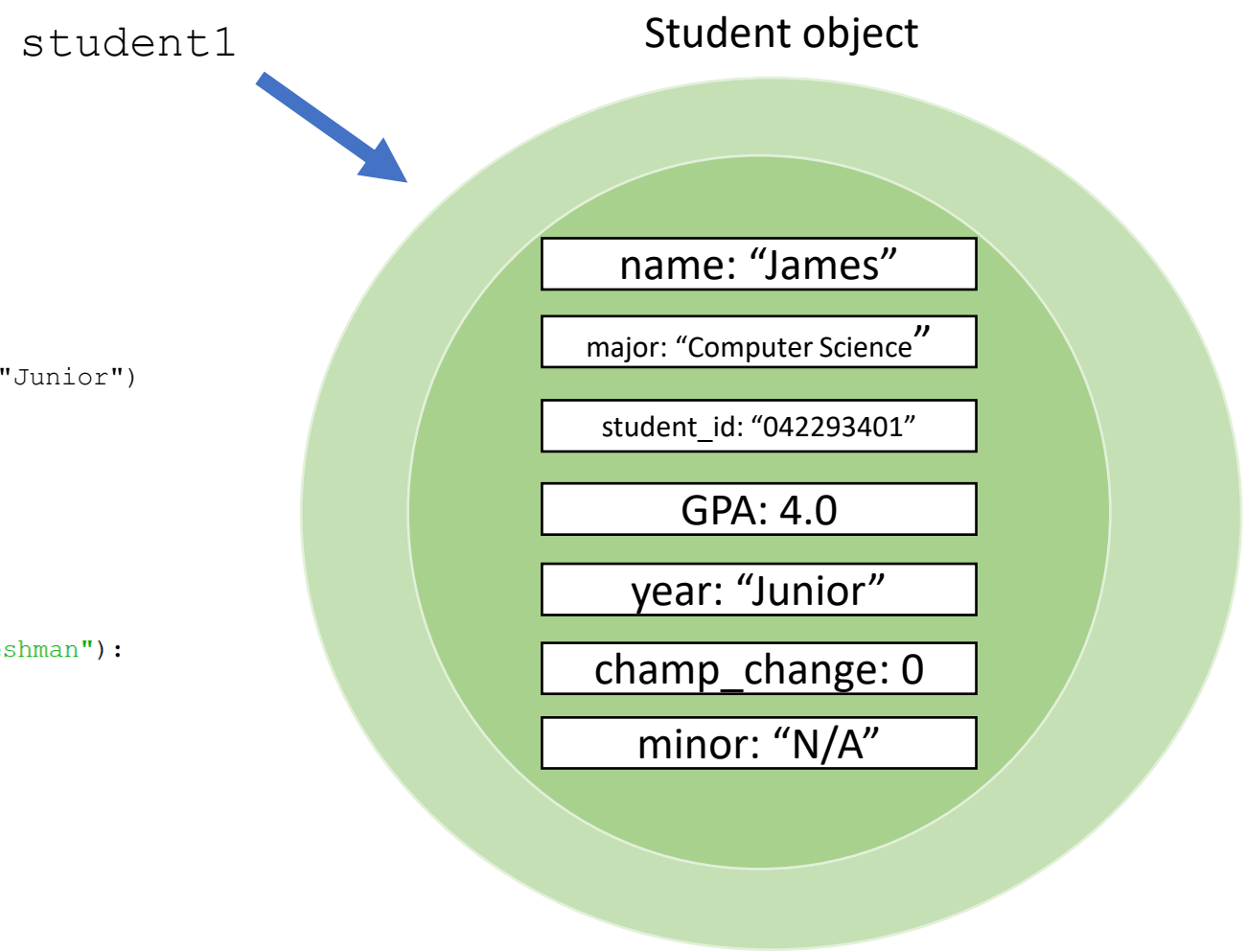
OOP Review

We create and use objects using **classes**

```
student1 = Student("James","Computer Science","04293401",4.0,"Junior")
```

We start off in our **constructor**

```
def __init__(self,name,major,student_id,gpa="Undefined",year="Freshman"):
    self.name = name
    self.major = major
    self.student_id = student_id
    self.gpa = gpa
    self.year = year
    self.champ_change = 0
    self.minor = "N/A"
```



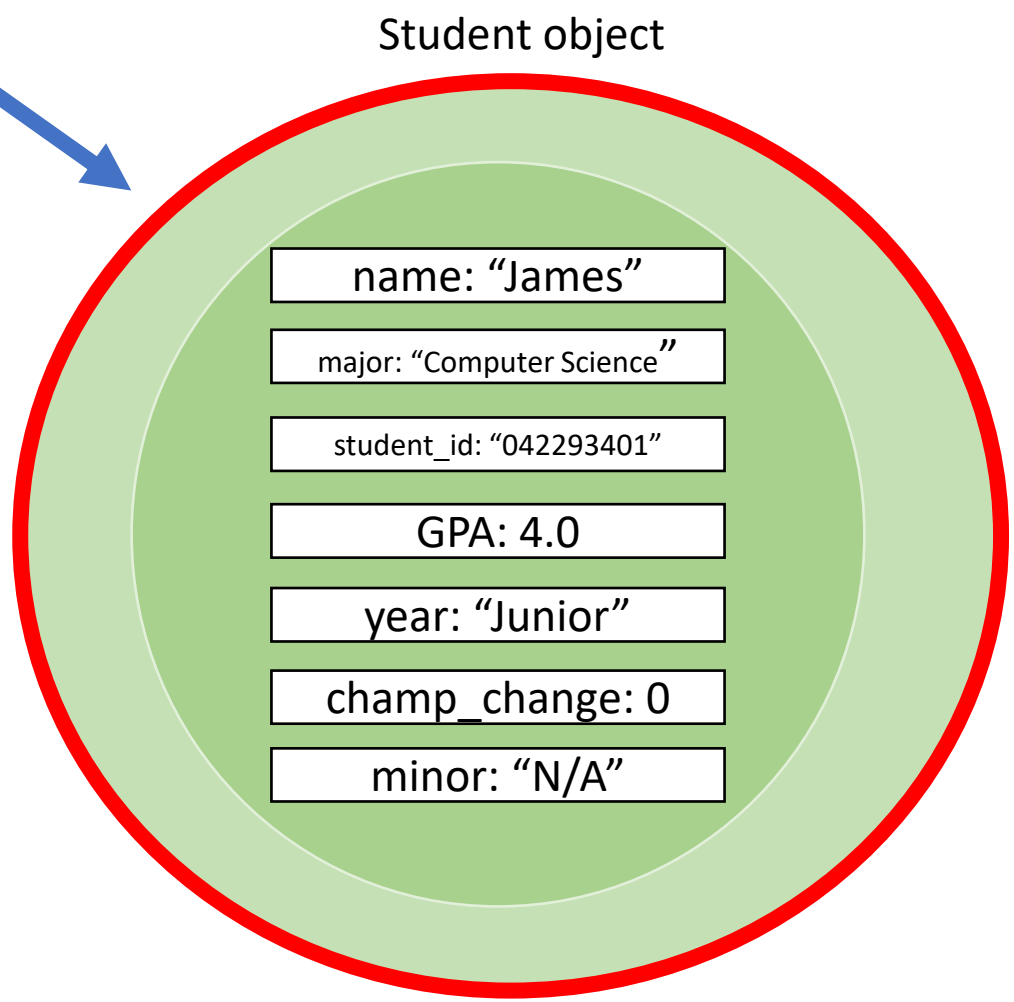
OOP Review

We create and use objects using **classes**

```
student1 = Student("James","Computer Science","04293401",4.0,"Junior")
```

We start off in our **constructor**

```
def __init__(self,name,major,student_id,gpa="Undefined",year="Freshman"):
    self.name = name
    self.major = major
    self.student_id = student_id
    self.gpa = gpa
    self.year = year
    self.champ_change = 0
    self.minor = "N/A"
```




```
print(student1)
```

```
<__main__.Student object at 0x03242D78>
```

Object’s Location in Memory

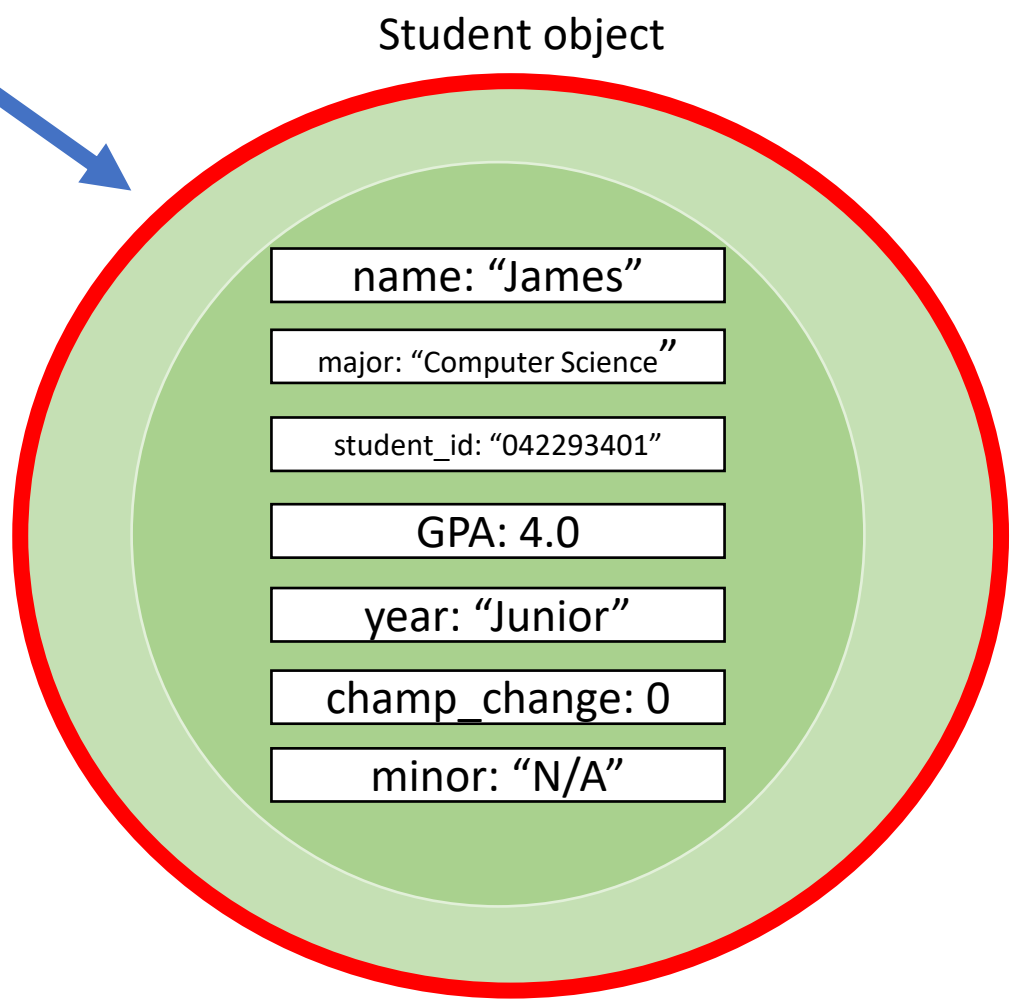
OOP Review

We create and use objects using **classes**

```
student1 = Student("James","Computer Science","04293401",4.0,"Junior")
```

We start off in our **constructor**

```
def __init__(self,name,major,student_id,gpa="Undefined",year="Freshman"):
    self.name = name
    self.major = major
    self.student_id = student_id
    self.gpa = gpa
    self.year = year
    self.champ_change = 0
    self.minor = "N/A"
```



Solution:
Overwrite what gets printed out using the __str__ method

```
print(student1)
```

```
<__main__.Student object at 0x03242D78>
```

Object’s Location in Memory

OOP Review

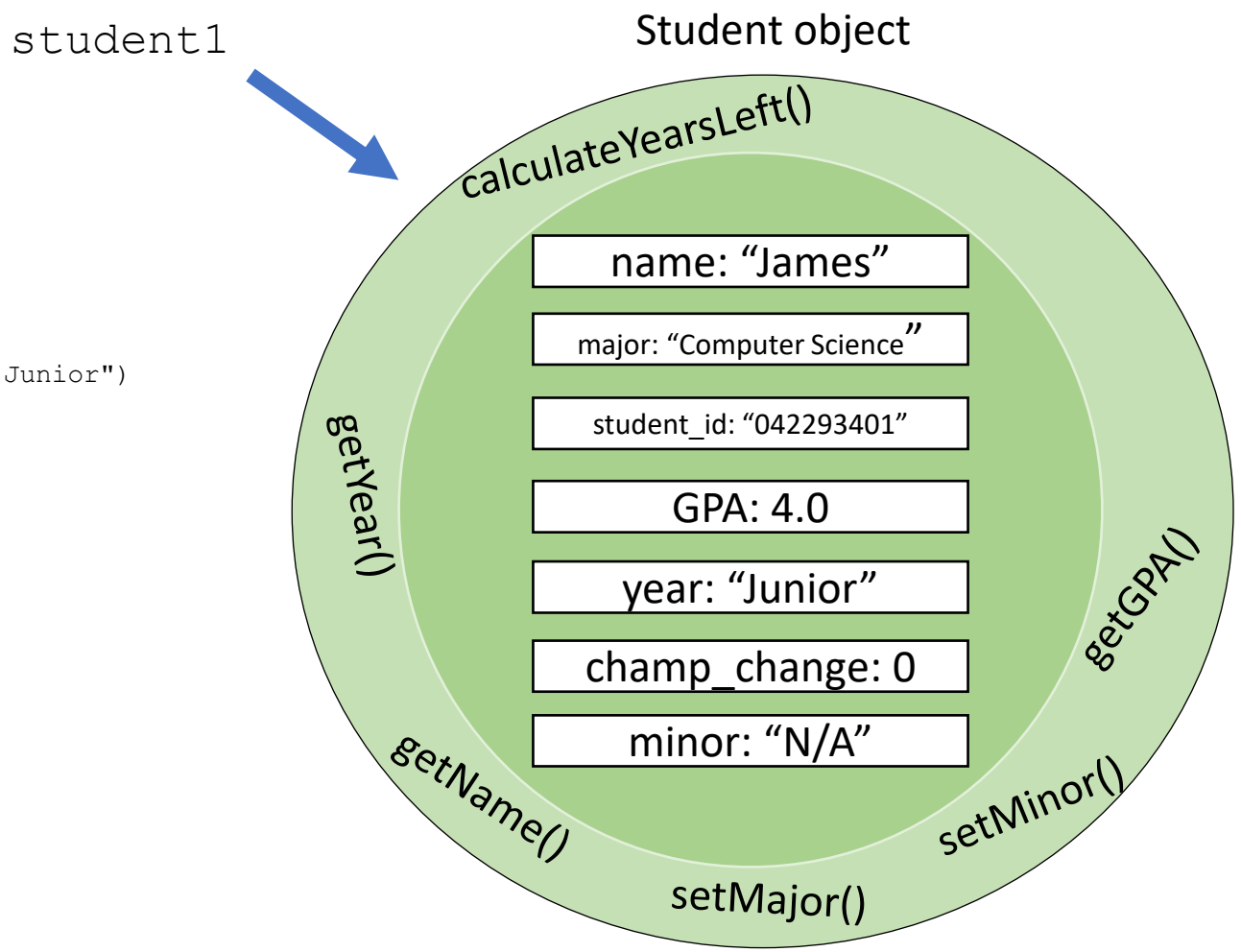
We create and use objects using **classes**

```
student1 = Student("James","Computer Science","04293401",4.0,"Junior")
```

We start off in our **constructor**

Our objects also have functionality (**methods**)

```
print(student1.getName())
```



OOP Review

We create and use objects using **classes**

```
student1 = Student("James","Computer Science","04293401",4.0,"Junior")
```

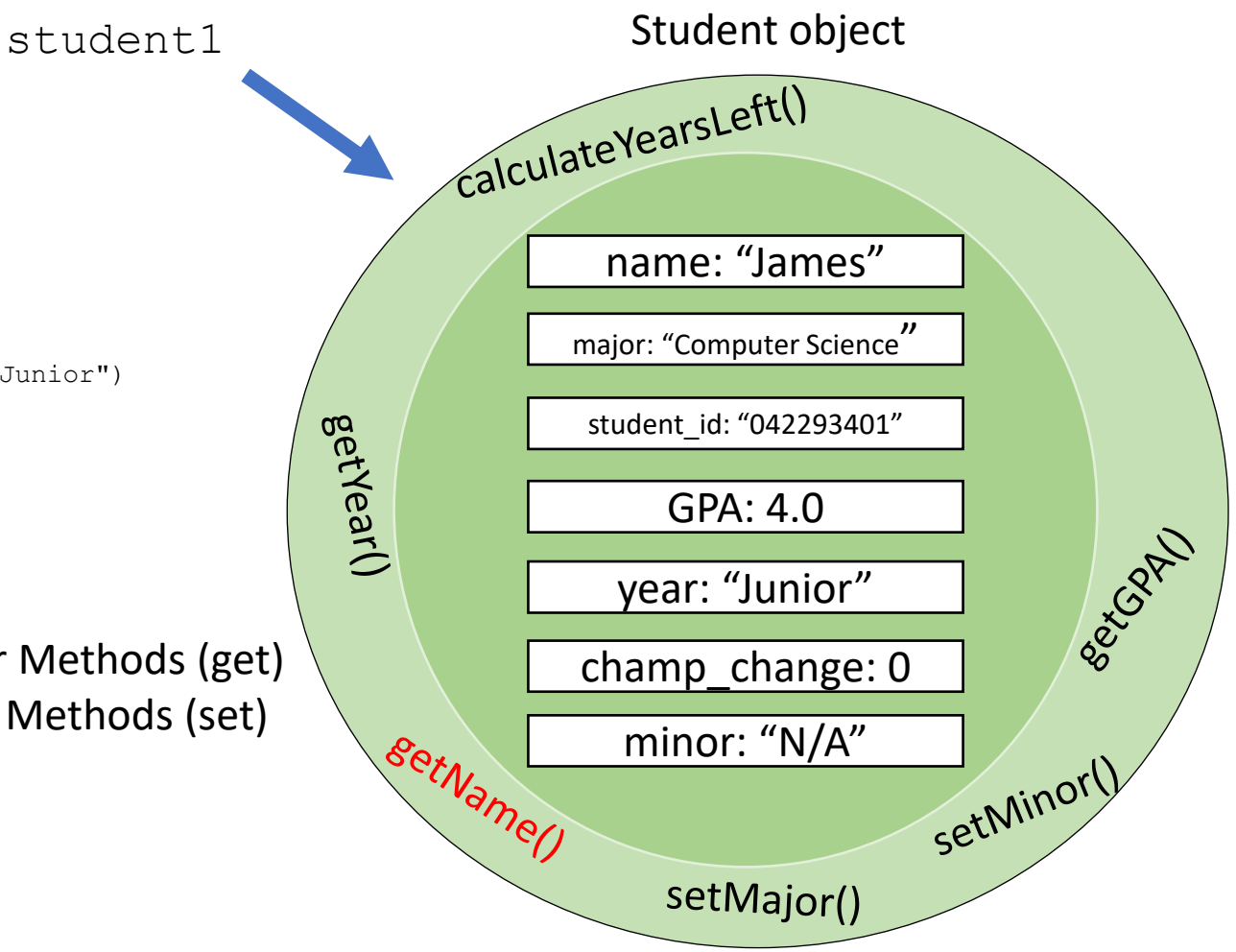
We start off in our **constructor**

Our objects also have functionality (**methods**)

Reader Methods (get)
Writer Methods (set)

```
def getName(self):
    return self.name
```

```
print(student1.getName())
```



OOP Review

We create and use objects using **classes**

```
student1 = Student("James","Computer Science","04293401",4.0,"Junior")
```

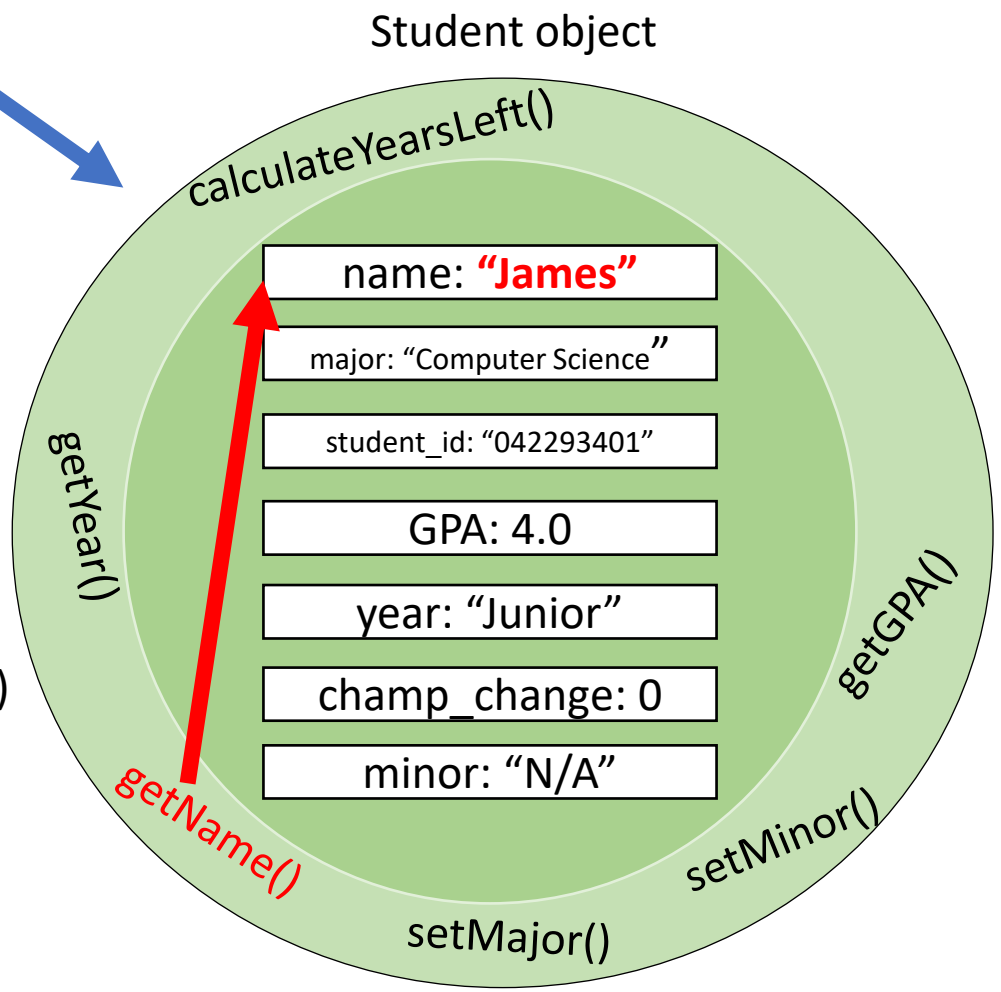
We start off in our **constructor**

Our objects also have functionality (**methods**)

Reader Methods (get)
Writer Methods (set)

```
def getName(self):
    return self.name
```

```
print(student1.getName())
```



OOP Review

We create and use objects using **classes**

```
student1 = Student("James","Computer Science","04293401",4.0,"Junior")
```

We start off in our **constructor**

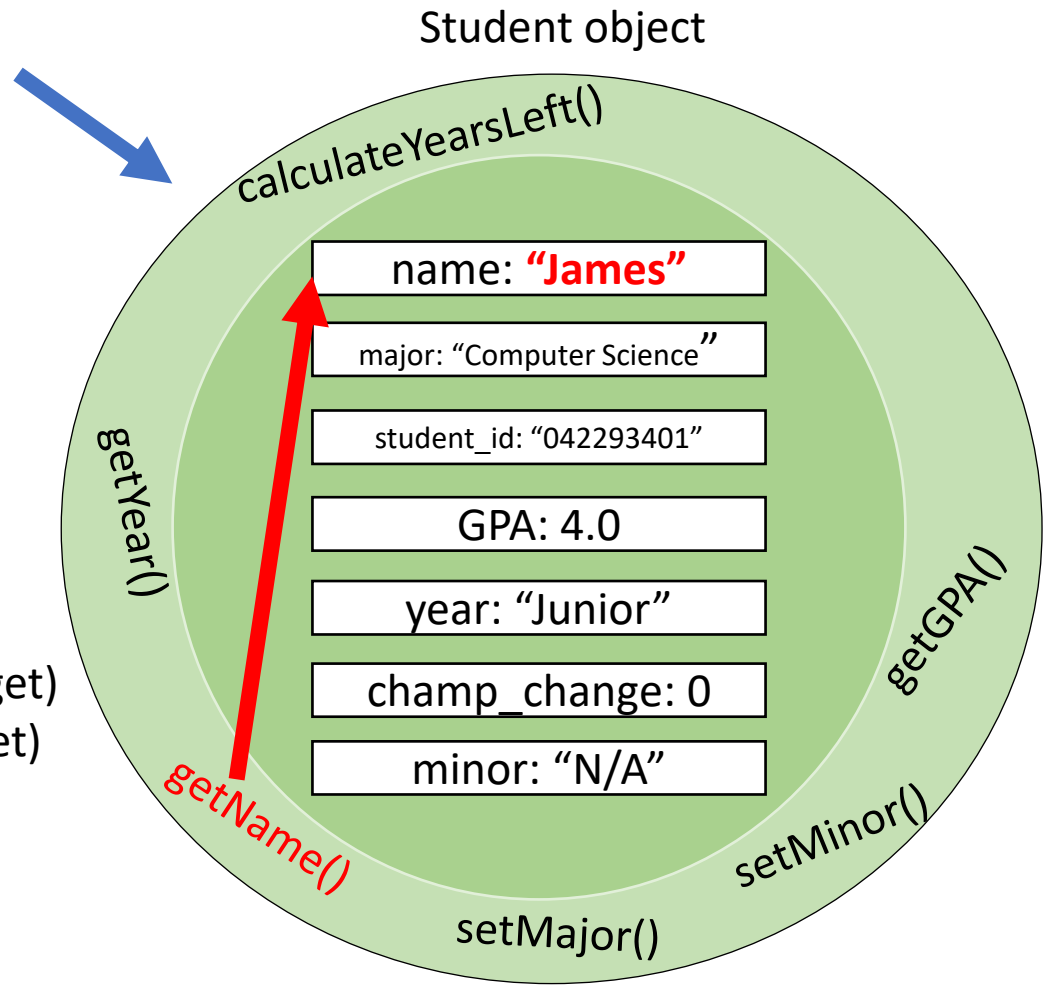
Our objects also have functionality (**methods**)

Reader Methods (get)
Writer Methods (set)

```
def getName(self):
    return self.name
```

```
print(student1.getName())
```

→ James



OOP Review

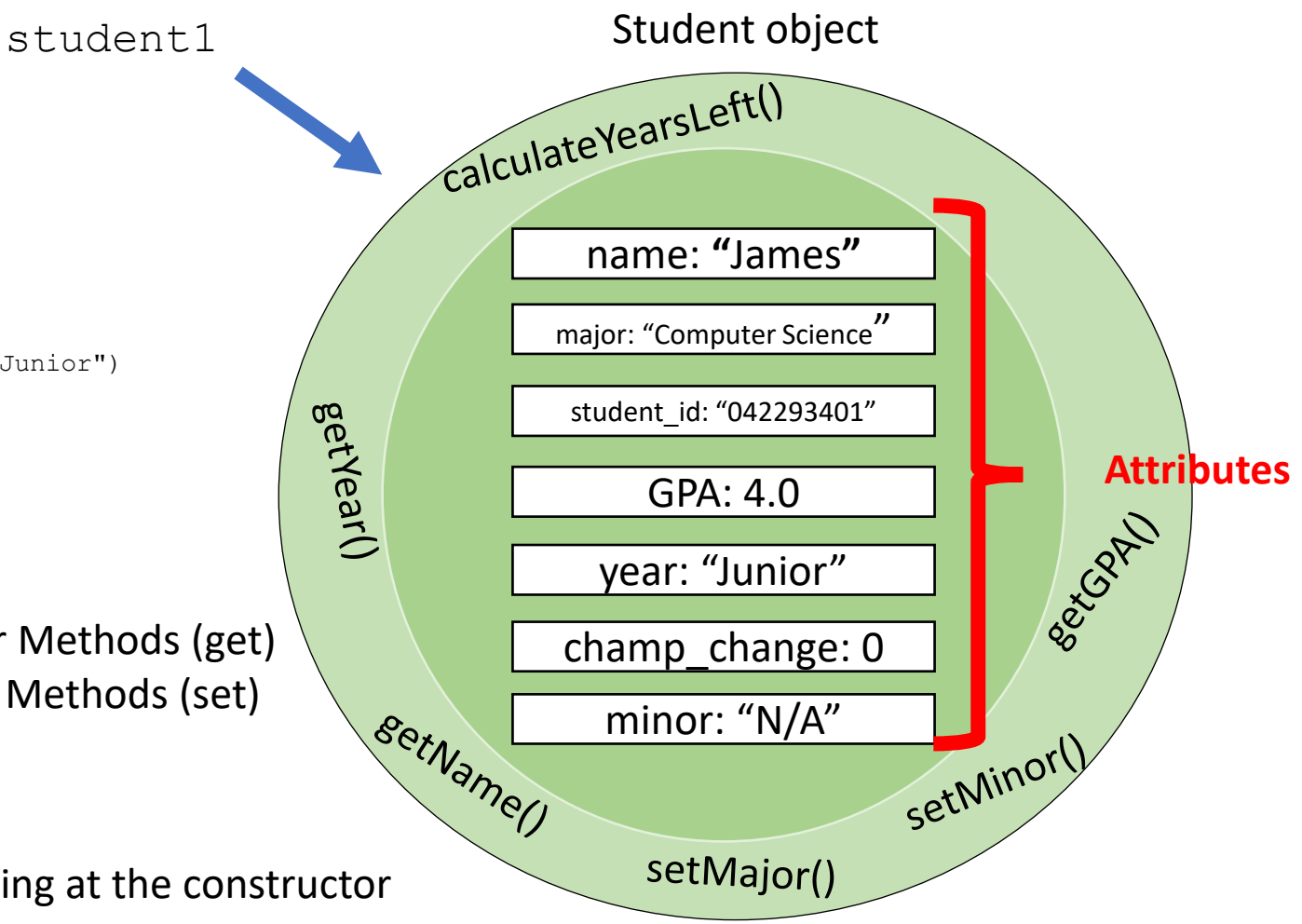
We create and use objects using **classes**

```
student1 = Student("James","Computer Science","04293401",4.0,"Junior")
```

We start off in our **constructor**

Our objects also have functionality (**methods**)
Reader Methods (get)
Writer Methods (set)

We can find the attributes/states of the object by looking at the constructor



OOP Review

We create and use objects using **classes**

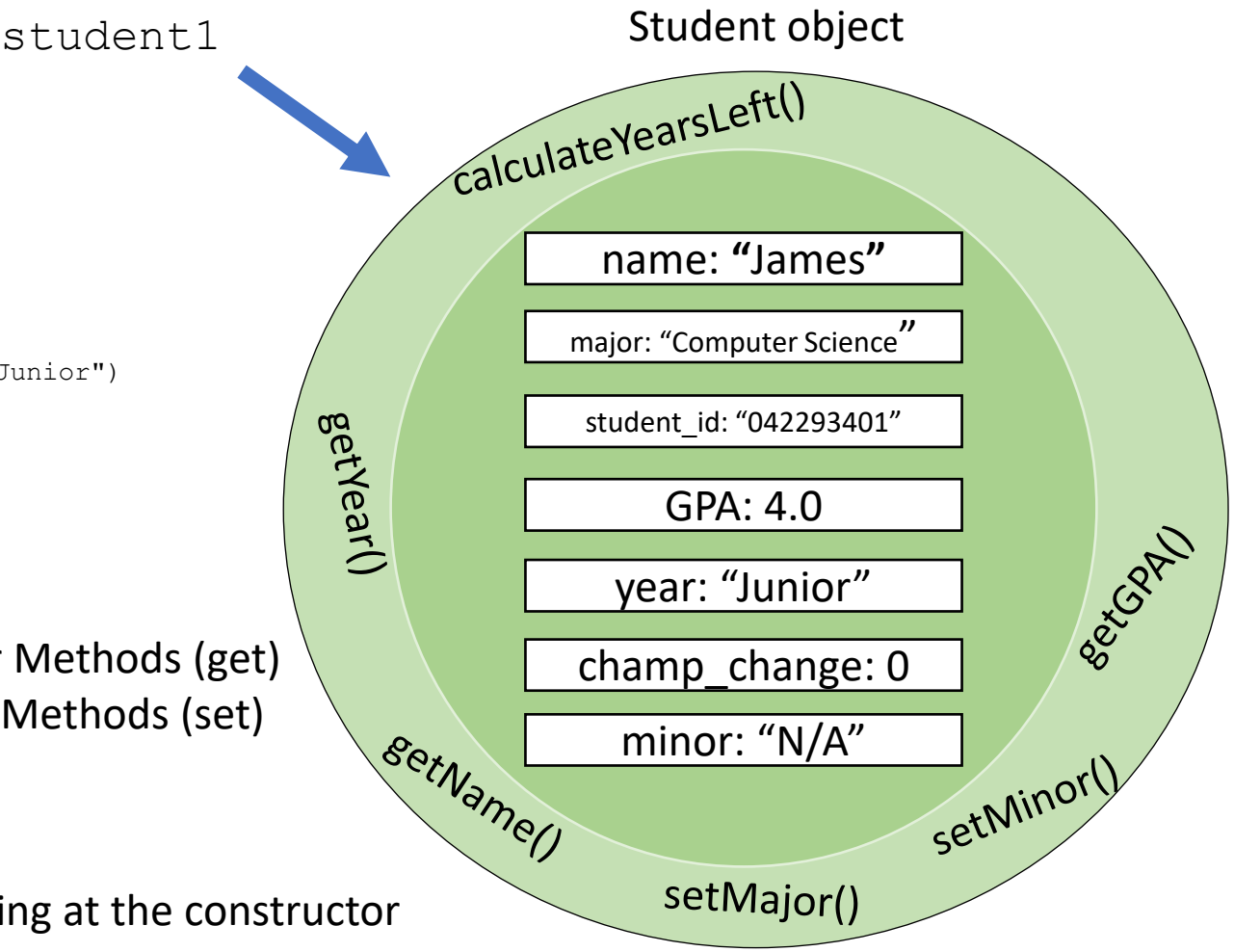
```
student1 = Student("James","Computer Science","04293401",4.0,"Junior")
```

We start off in our **constructor**

Our objects also have functionality (**methods**)

Reader Methods (get)
Writer Methods (set)

We can find the attributes/states of the object by looking at the constructor

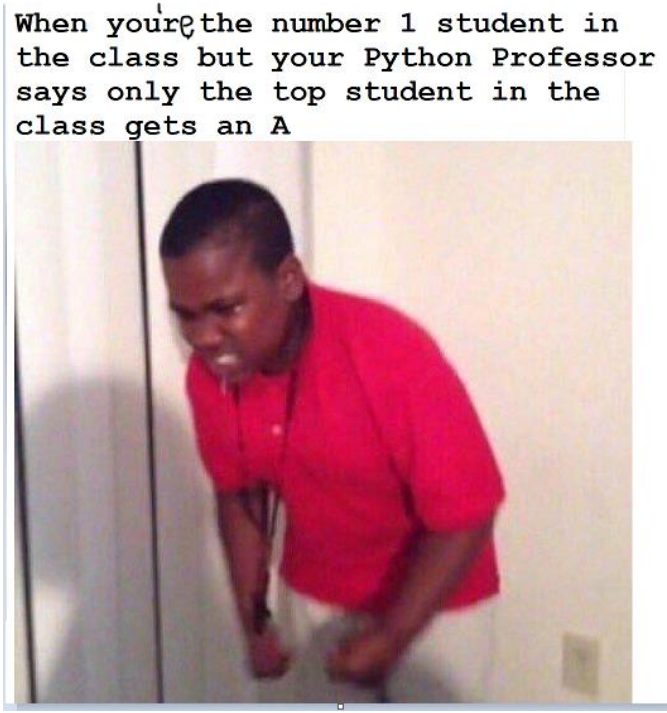


Announcements (Tuesday)

Lab 7 due **tonight** (Tuesday 11:59 PM)

Lab 8 due **Thursday** (Tuesday 11:59 PM)

Program 4 due **Sunday** @ 11:59 PM



meme made by reese

Today:

More OOP

OOP Example

Construct a **quarterback** class. Each quarterback will have:

- Name
- Attempts
- Completions
- Passing Yards
- Touchdowns
- Interceptions

$$a = \left(\frac{\text{COMP}}{\text{ATT}} - .3\right) \times 5$$

$$b = \left(\frac{\text{YDS}}{\text{ATT}} - 3\right) \times 0.25$$

$$c = \left(\frac{\text{TD}}{\text{ATT}}\right) \times 20$$

$$d = 2.375 - \left(\frac{\text{INT}}{\text{ATT}} \times 25\right)$$

$$\text{Passer Rating} = \left(\frac{a+b+c+d}{6}\right) \times 100$$

The class should be able to calculate the **completion percentage**, **passing yards per attempt**, and **quarterback passer rating**

There should also be all necessary getter/setter methods

OOP Example

Let’s create a Python class using billionaires.csv that is going to represent information about Billionaires

Each Billionaire has a

Name
Company Name
Age
Gender
Worth in Billions
Location (Continent)

Lets write some functions that can

- Search for billionaires that make more money than a certain threshold
- Print out # of male vs female billionaires
- Print out number of Billionaires based on Continent

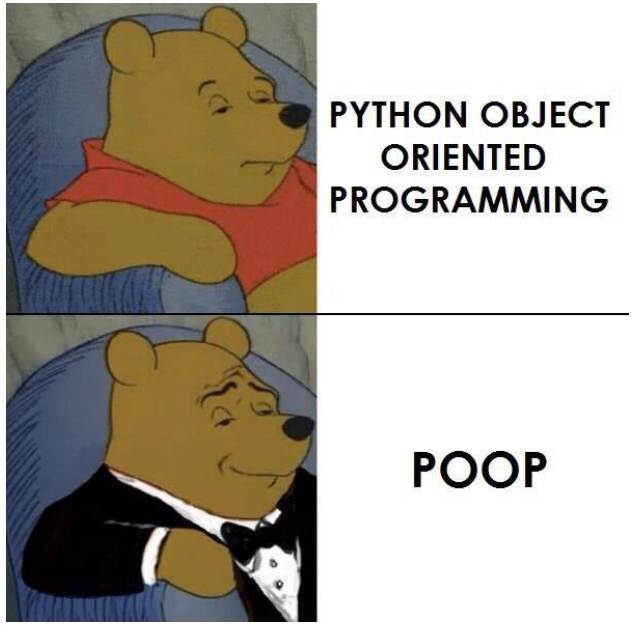
This example will be helpful for program 4

Announcements

Lab 8 due **Thursday**

Program 4 due **Sunday**

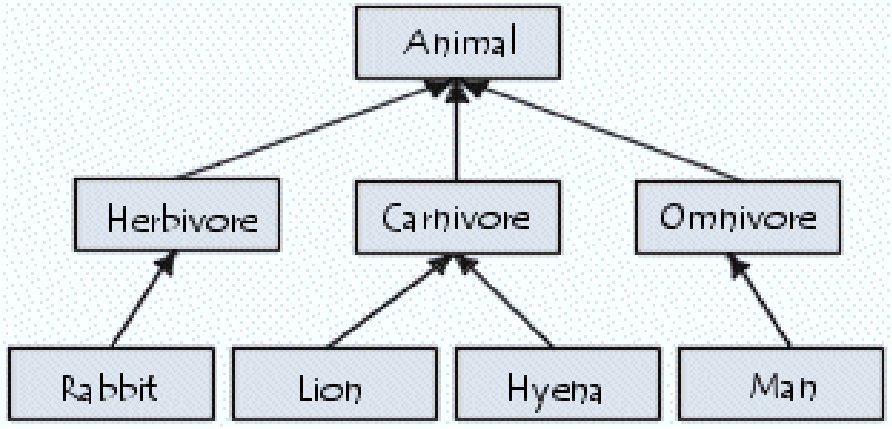
Cutting a few lectures today and
tomorrow to give you time to catch up ☺



Today:
Inheritance, Magic Methods

Inheritance is an OOP principle that allows us to create structure and hierarchy in our classes

Inheritance allows us to derive a class from another class to get access to attributes and methods.
This creates a set of “shared” attributes and methods across different classes



Accountant "inherits from" Employee

To inherit from another class, you need to provide the Class name of the parent

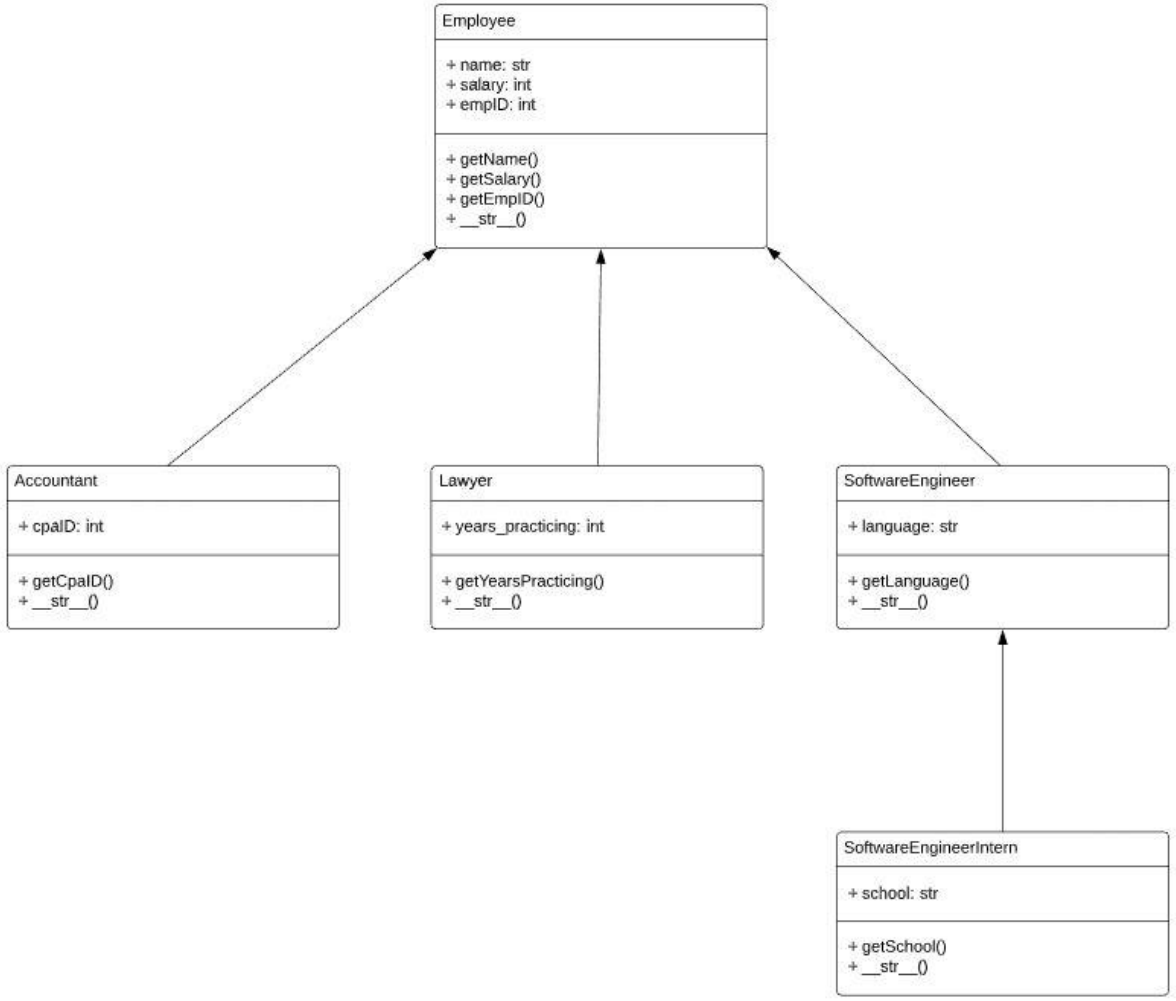
```
class Accountant(Employee):

    def __init__(self,name,salary,empID,cpaID):
        Employee.__init__(self,name,salary,empID)
        self.cpaID = cpaID

    def getCpaID(self):
        return self.cpaID

    def   str  (self):
```

Then, call the parent constructor inside of the child constructor

You now have access to the attributes and methods in the parent class

Another way using the super() keyword

```
class Lawyer(Employee):

    def __init__(self,name,salary,empID,years_practicing):
        #another way to call the parent class
        super().__init__(name,salary,empID)
        self.years_practicing = years_practicing
```



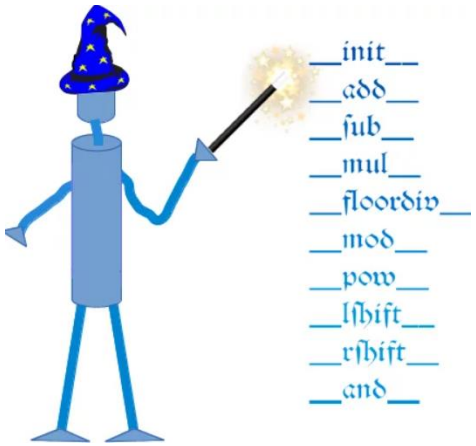
Engineers create **UML Diagrams** to illustrate how classes interact with each other

These help engineers understand how software systems are structured without needing to dive deep into the source code

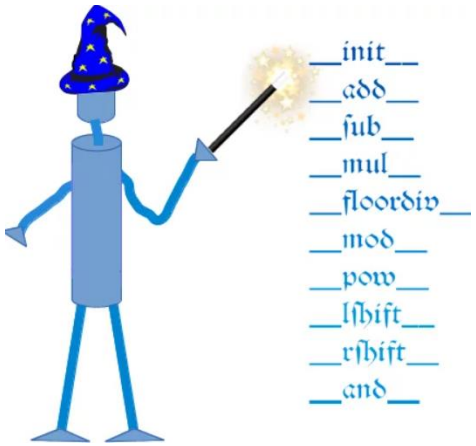
If you are a CS major, you will make plenty of these ☺

Magic Methods

Allows us to control the behavior of our program when doing an operation on an object

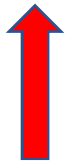


Magic Methods



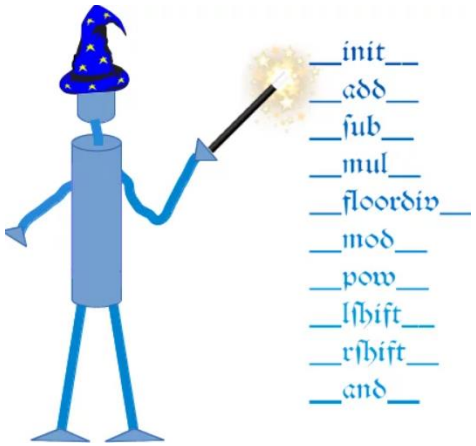
Allows us to control the behavior of our program when doing an operation on an object

```
food_order = Order("McDonalds",10.99)

drink_order = Order("Starbucks",7.50)

total = food_order + drink_order

print(total)
```



What happens when we try to add two objects together??

Magic Methods



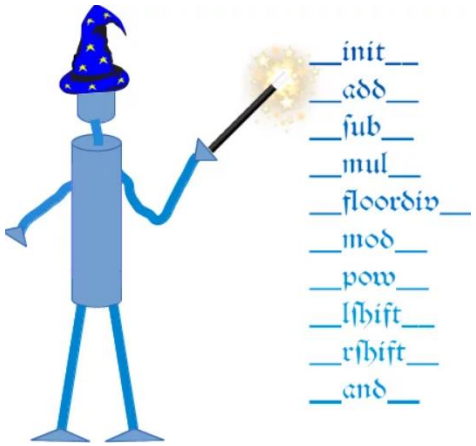
Allows us to control the behavior of our program when doing an operation on an object

```
food_order = Order("McDonalds",10.99)

drink_order = Order("Starbucks",7.50)

total = food_order + drink_order

print(total)
```

What happens when we try to add two objects together??

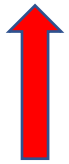
```
TypeError: unsupported operand type(s) for +: 'Order' and 'Order'
```

Magic Methods



Allows us to control the behavior of our program when doing an operation on an object

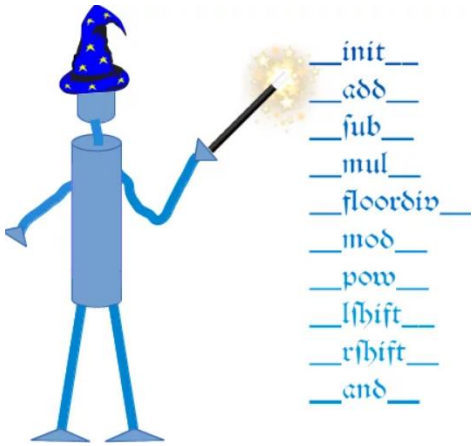
```
food_order = Order("McDonalds",10.99)

drink_order = Order("Starbucks",7.50)

total = food_order + drink_order

print(total)
```



What happens when we try to add two objects together??

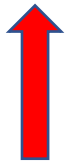
We can tell Python and control what we want to happen if we try to add two objects !!

Magic Methods



Allows us to control the behavior of our program when doing an operation on an object

```
food_order = Order("McDonalds",10.99)

drink_order = Order("Starbucks",7.50)

total = food_order + drink_order

print(total)
```

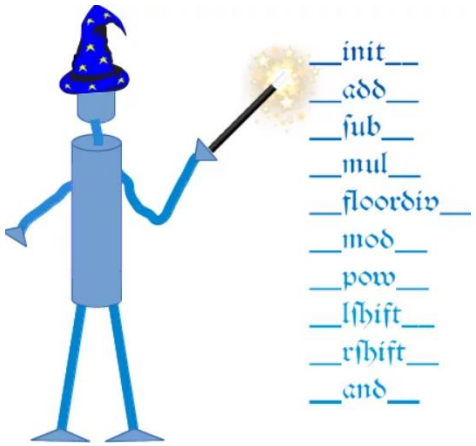


What happens when we try to add two objects together??

We can tell Python and control what we want to happen if we try to add two objects !!

using **Magic Methods**

Magic Methods



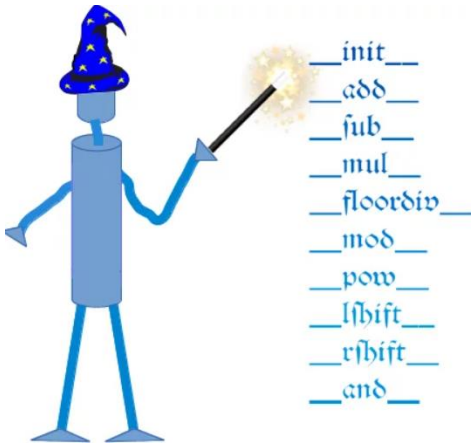
Allows us to control the behavior of our program when doing an operation on an object

```
food_order = Order("McDonalds",10.99)

drink_order = Order("Starbucks",7.50)


total = food_order + drink_order

print(total)
```

Controls behavior of the + operator

```
def __add__(obj1, obj2):
    return obj1.price + obj2.price
```

Magic Methods



Allows us to control the behavior of our program when doing an operation on an object

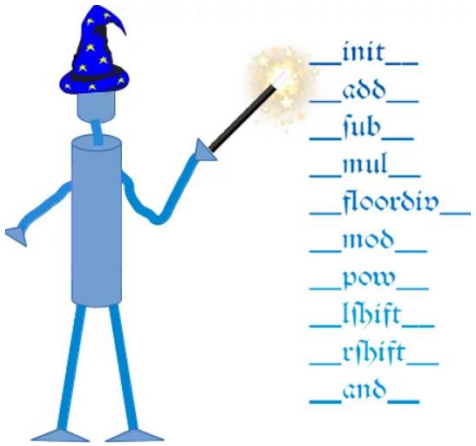
```
food_order = Order("McDonalds",10.99)

drink_order = Order("Starbucks",7.50)

total = food_order + drink_order

print(total)
```

Controls behavior of the + operator

```
def __add__(obj1, obj2):
    return obj1.price + obj2.price
```

When we use the + operator, we are always doing an operator between **two** objects

Magic Methods



Allows us to control the behavior of our program when doing an operation on an object

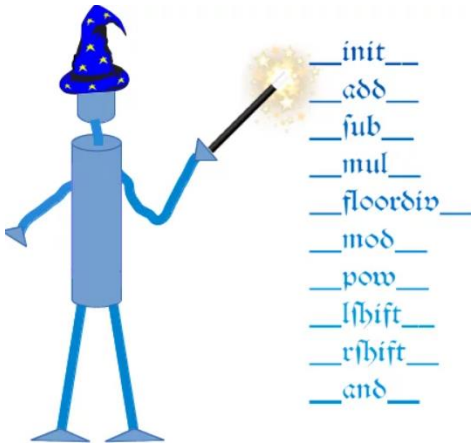
```
food_order = Order("McDonalds",10.99)

drink_order = Order("Starbucks",7.50)

total = food_order + drink_order

print(total)
```

Controls behavior of the + operator

```
def __add__(obj1, obj2):
    return obj1.price + obj2.price
```

When we use the + operator, we are always doing an operator between **two** objects

Magic Methods



Allows us to control the behavior of our program when doing an operation on an object

```
food_order = Order("McDonalds",10.99)

drink_order = Order("Starbucks",7.50)

total = food_order + drink_order

print(total)
```

Controls behavior of the + operator

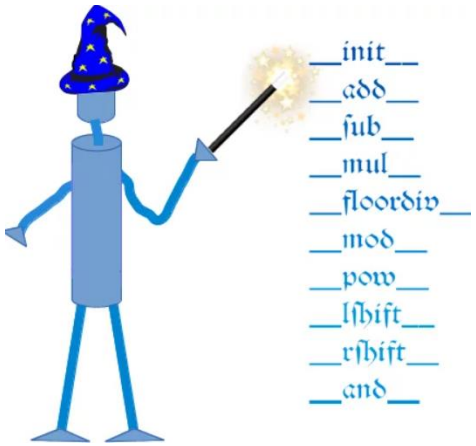
```
def __add__(obj1, obj2):
    return obj1.price + obj2.price
```

When we use the + operator, we are always doing an operator between **two** objects

Now that we have a magic method defined, we can get an answer!

```
18.490000000000002
```

Magic Methods



List of magic methods

https://www.python-course.eu/python3_magic_methods.php