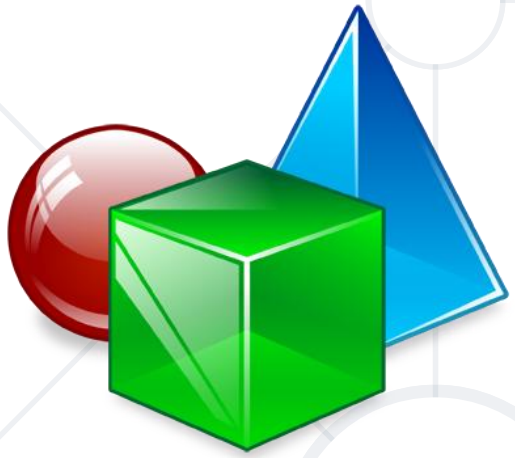
Classes and Objects



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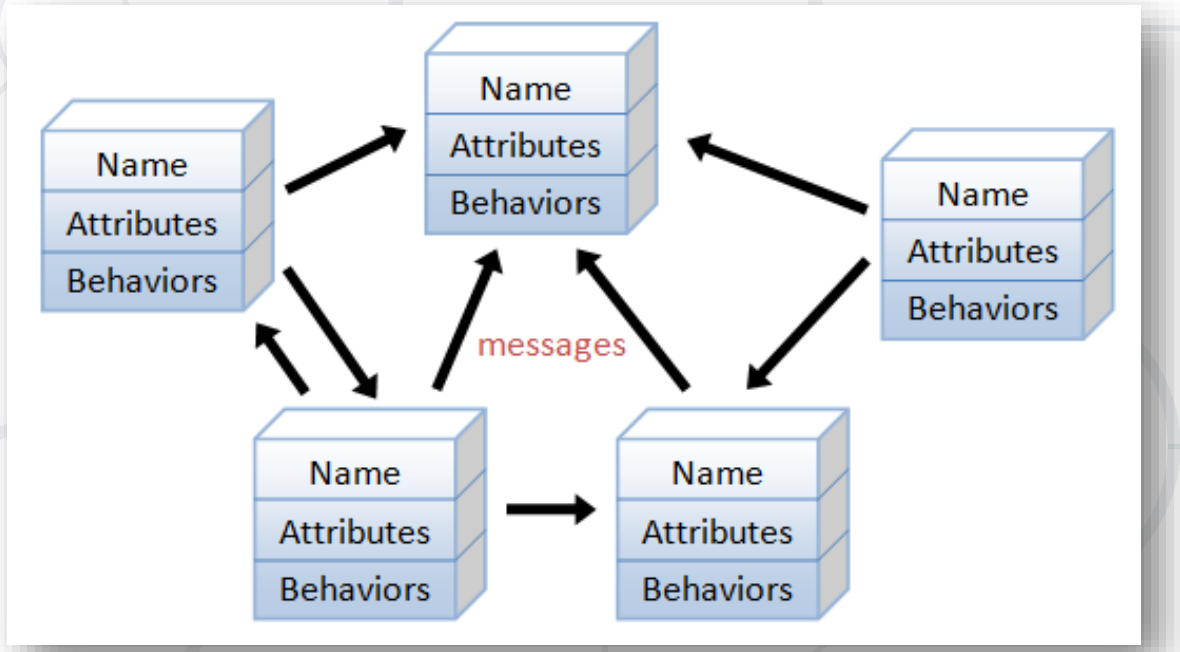
Object Oriented Programming

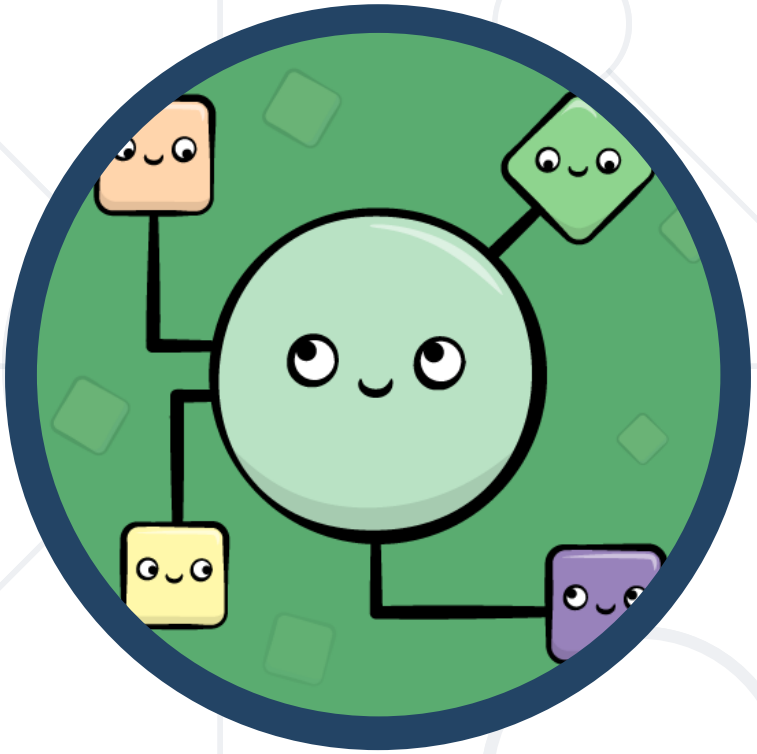
What is OOP?

- OOP is a programming **paradigm**
- Provides a means of **structuring** programs so that properties and behaviors are bundled into individual **objects**
- Objects are at the center of the OOP paradigm

Example

- An object-oriented program consists of objects that **interact** with each other





Classes

Template for Objects

Class Definition

- A **class** is like a **blueprint** for creating **objects**
- Classes provide a means of bundling data and functionality together
- Each class instance can have **attributes** attached to it
- Class instances can also have **methods** for modifying its state

The __init__() Function

- All classes create objects, and all objects contain characteristics called **attributes**
- The `__init__()` method initializes an object's initial attributes by giving them their default value
- The double leading and trailing underscore is used for **special variables** or **methods**

The self Variable

- The `self` parameter is a reference to the current **instance** of the class
- Used to access variables that belong to the class
- When defining an **instance** method, the first parameter of the method should always be `self`

Class Example

- Create a **class Person** that has, **first name**, **last name**, and **age**

```
class Person:
    def __init__(self, first_name, last_name, age=0):
        self.first_name = first_name
        self.last_name = last_name
        self.age = age
```

Default value

- When a parameter is **optional**, but a **default value** that it should have

Problem: Comment

- Create a class with the name **"Comment"**
- The `__init__` method should accept **3 parameters**
  - username
  - content
  - likes (optional, 0 by default)
- Use the exact names of your variables

Solution: Comment

```
class Comment:
    def __init__(self, username, content, likes=0):
        self.username = username
        self.content = content
        self.likes = likes
```

Objects

Instances of Classes

Object Definition

- **Instance** is a concrete object of the type of the class
- A class is like a form or a template
  - It defines the needed information
- You can fill out multiple copies, but without the form, you will not know the required information

Object Example

- Using the **Person** class we created, here we have an example of the instance of that class

```
me = Person("Peter", "Johnson", 25)
print(me.first_name) # Peter
print(me.last_name)  # Johnson
print(me.age)        # 25
```

Accessing object attributes

Modifying Attributes

- You can change the values of the attributes of an object after initialization

```
me = Person("Peter", "Johnson", 25)
me.age += 1
print(me.age) # 26
```

- The change will be made only for that instance of the class

Problem: Party

- Create a **class Party** that only has an attribute called **people**
- The **`__init__`** method should not accept any parameters
- You will be given names of people (on separate lines) until you receive the command "**`End`**"
- Print 2 lines:
  - "**`Going: `**" + all the people separated by comma and space
  - "**`Total: {total_people_going}`**"

Solution: Party

```
class Party:
    def __init__(self):
        self.people = []
party = Party()
line = input()
while line != "End":
    party.people.append(line)
    line = input()
print(f"Going: {', '.join(party.people)}")
print(f"Total: {len(party.people)}")
```

Class Attributes and Instance Methods

Class Attributes

- While instance attributes are specific to each object, class attributes are the same for all instances

```
class Person:
    species = "mammal"
    def __init__(self, name, age):
        self.name = name
        self.age = age
me = Person("Peter", 25) # me.species = "mammal"
you = Person("John", 44) # you.species = "mammal"
```

Instance Methods

- Instance methods are defined **inside a class** and are used to get the **contents of an instance**
- They can also be used to perform **operations** with the **attributes** of our objects
- Like the `__init__` method, the first argument should always be `self`

Code Example

```
class Person:
    def __init__(self, first_name, last_name, age):
        self.first_name = first_name
        self.last_name = last_name
        self.age = age
    def get_full_name(self):
        return f"{self.first_name} {self.last_name}"
me = Person("Peter", "Johnson", 64)
print(me.get_full_name()) # Peter Johnson
```

Problem: Email

- Create a class **Email** as described in the lab description
- You will receive some emails until you receive "**Stop**" (separated by a single space)
- The **first** will be the **sender**, the **second** one – the **receiver** and the **third** one – the **content**
- On the final line you will be given the indices of the **sent emails** separated by comma and space. For each email print:
  "{sender} says to {receiver}: {content}. Sent: {is_sent}"

Solution: Email (the Class)

```
class Email:
    def __init__(self, sender, receiver, content):
        self.sender = sender
        self.receiver = receiver
        self.content = content
        self.is_sent = False
    def send(self):
        self.is_sent = True
    def get_info(self):
        return f"{self.sender} says to {self.receiver}:
{self.content}. Sent:
        {self.is_sent}"
```

Solution: Email (the Logic)

```
emails = []
line = input()
while line != "Stop":
    tokens = line.split(" ")
    email = Email(tokens[0], tokens[1], tokens[2])
    emails.append(email)
    line = input()
    send_emails = [int(x) for x in input().split(", ")]
for x in send_emails:
    emails[x].send()
# TODO: print the emails
```

Problem: Zoo

- Create a **class Zoo** as described in the lab description
- On the first line you will receive the **name** of the zoo
- On the second line you will receive the number **n**
- On the next **n lines** you will receive animal info in the format: "**`{species} {name}`**". Add the animal to the zoo
- On the final line you will receive a **species**
- Print all the info for that species and the total count of animals

Solution: Zoo (the Class)

```
class Zoo:
    def __init__(self, name):
        self.name = name
        # TODO: create 3 lists (mammals, fishes, birds)
    def add_animal(self, species, name):
        # TODO: add the name to the given species
    def get_info(self, species):
        # TODO: create the resulting string and return it
```

Solution: Zoo (the Logic)

```
zoo_name = input()
zoo = Zoo(zoo_name)
count = int(input())
total_animals = 0
for i in range(count):
    # Read the input
    # Add the new animal
    # Update the total_animals variable
info = input()
print(zoo.get_info(info))
```

Summary

- What does OOP mean
- What classes are and how to create them
- What instances are and how to create them
- What attributes and instance methods are

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