# Python: Day 03

Object-Oriented Programming

# Previous Agenda

01

## Lists & Tuple

Ordered Group

02

## Dictionary & Set

Unordered Group

03

## String

Handling Text

04

## File Handling

Data outside code

05

## Comprehension

Iteration Shortcut

06

## Lab Session

Culminating Exercise

# Agenda

01

## Definition

Data-Centric Approach

02

## Hierarchy

Organizing Data

03

## Polymorphism

Handling data types

04

## Encapsulation

Data Hiding

05

## GUI

Introduction to Tkinter

06

## Lab Session

Culminating Exercise

01

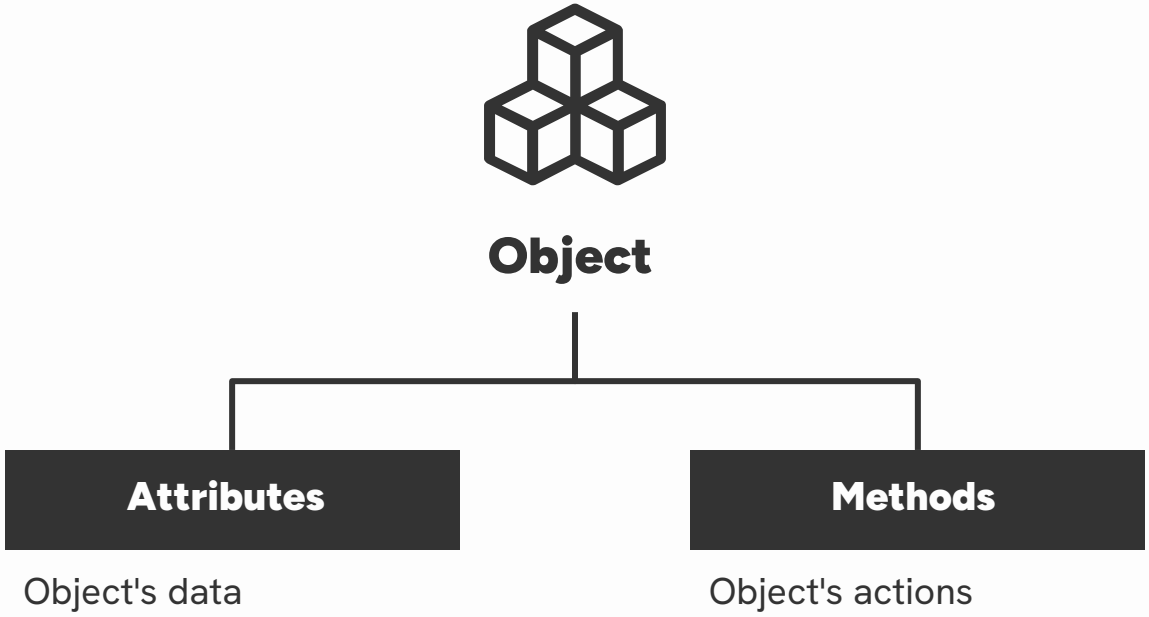
# Definition

Programming with a focus on concepts

# What makes something something ?


PARKER
PARKER

# What is Object Oriented Programming?




# Has → Is

# Functional Identity

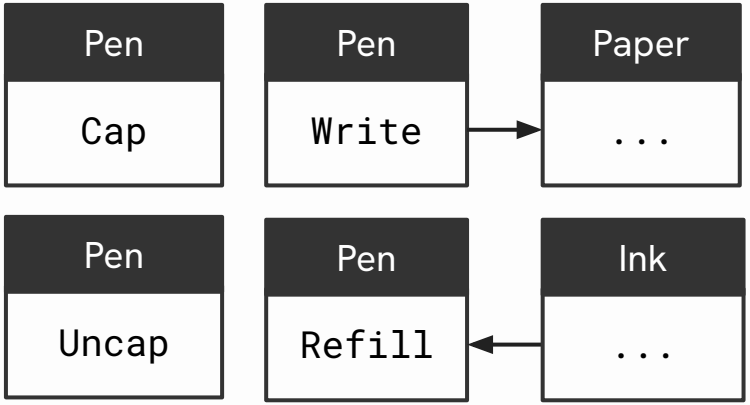
## Attributes

- Attributes are unique to one object

| Pen | |
|---|---|
| brand | Pilot |
| color | Black |
| capped | False |

## Methods

- Methods can change itself or others



# Object Similarities

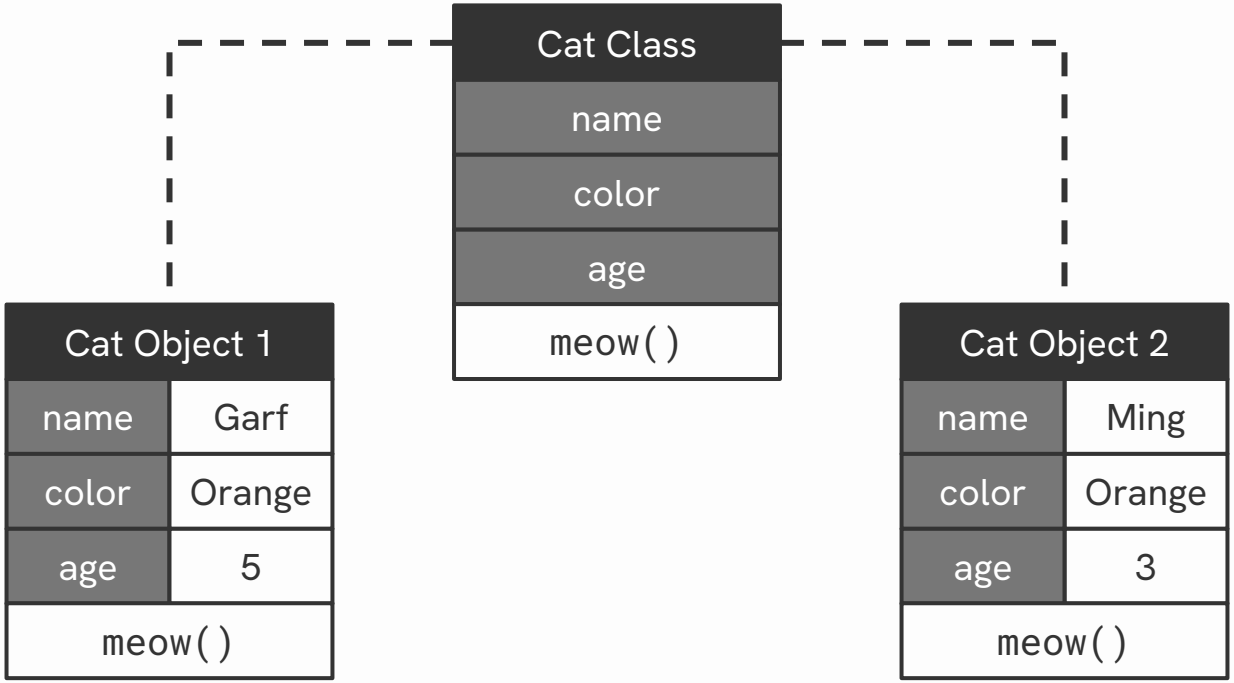
| cat1 | |
|---|---|
| name | Garf |
| color | Orange |
| age | 5 |
| `meow()` | |

| cat2 | |
|---|---|
| name | Ming |
| color | Orange |
| age | 3 |
| `meow()` | |

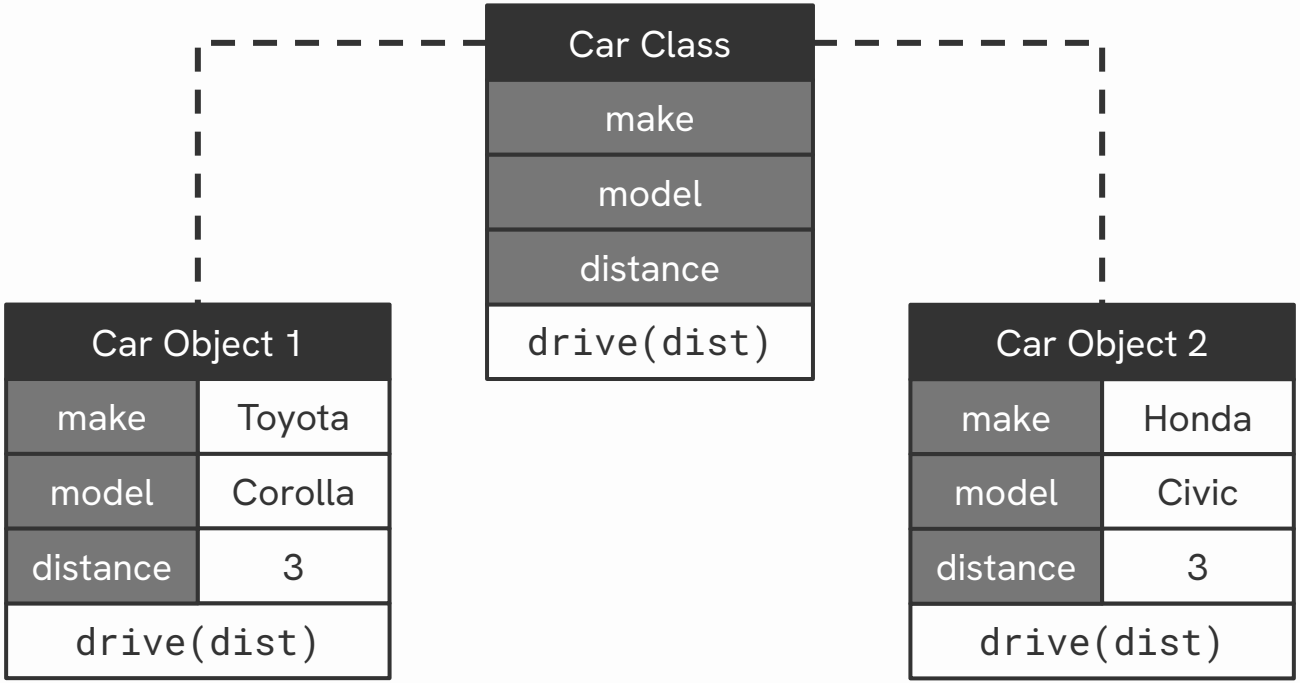
| cat3 | |
|---|---|
| name | Mona |
| color | Black |
| age | 2 |
| `meow()` | |

## What makes them different/same?

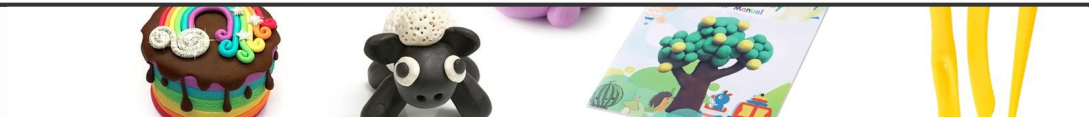
# Classes to Objects

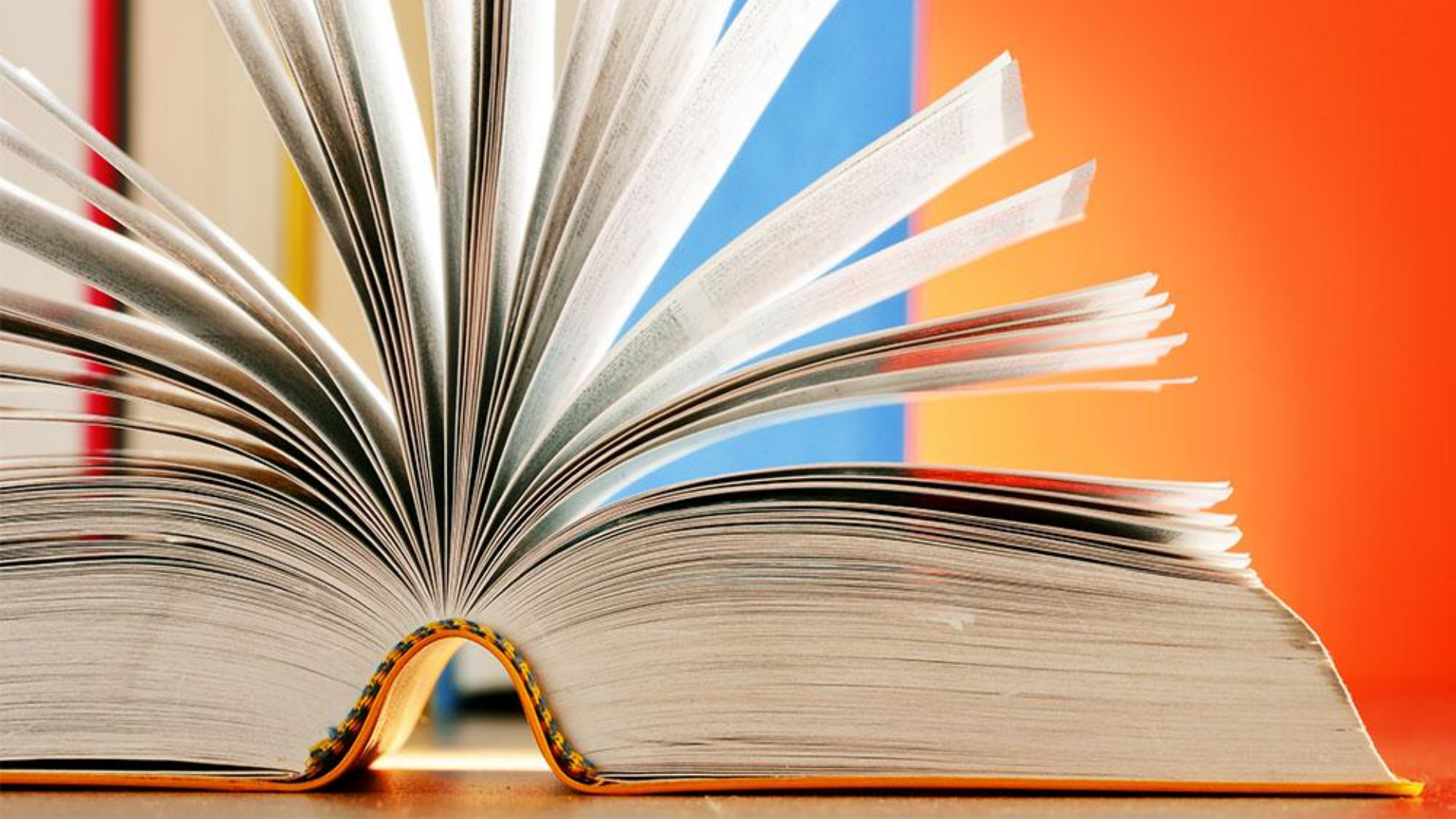


# Classes to Objects



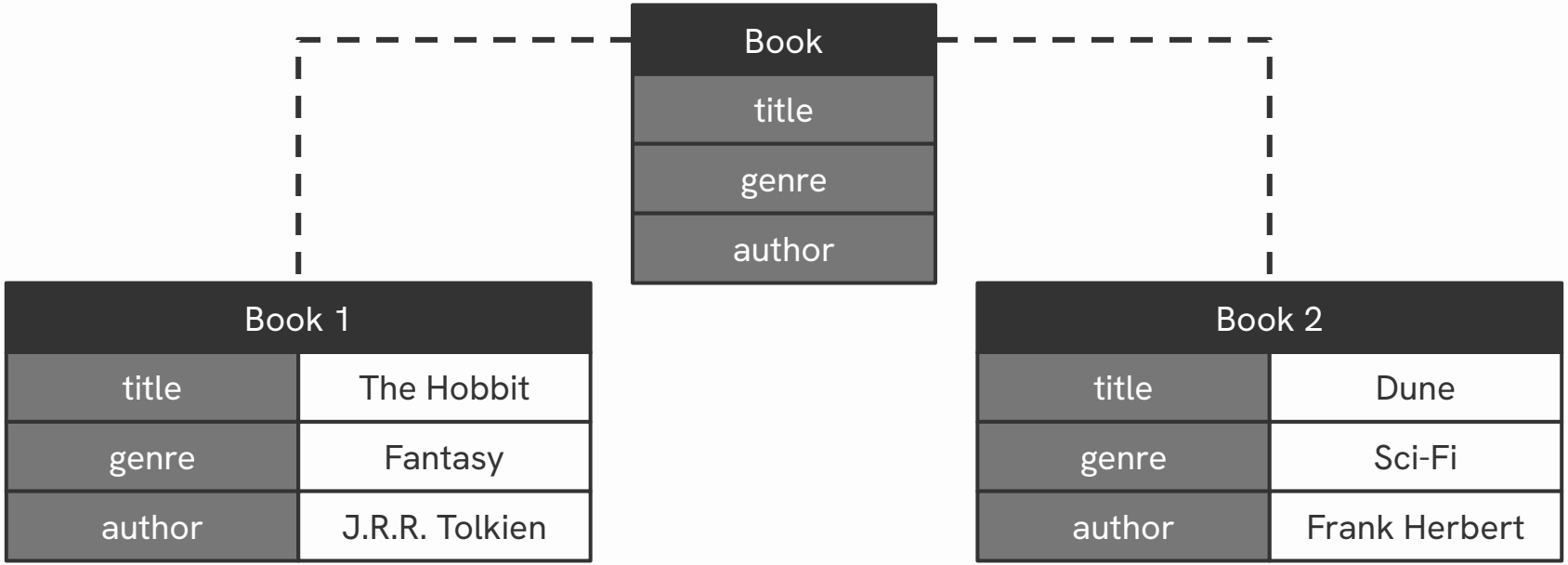

# Modelling Exercise



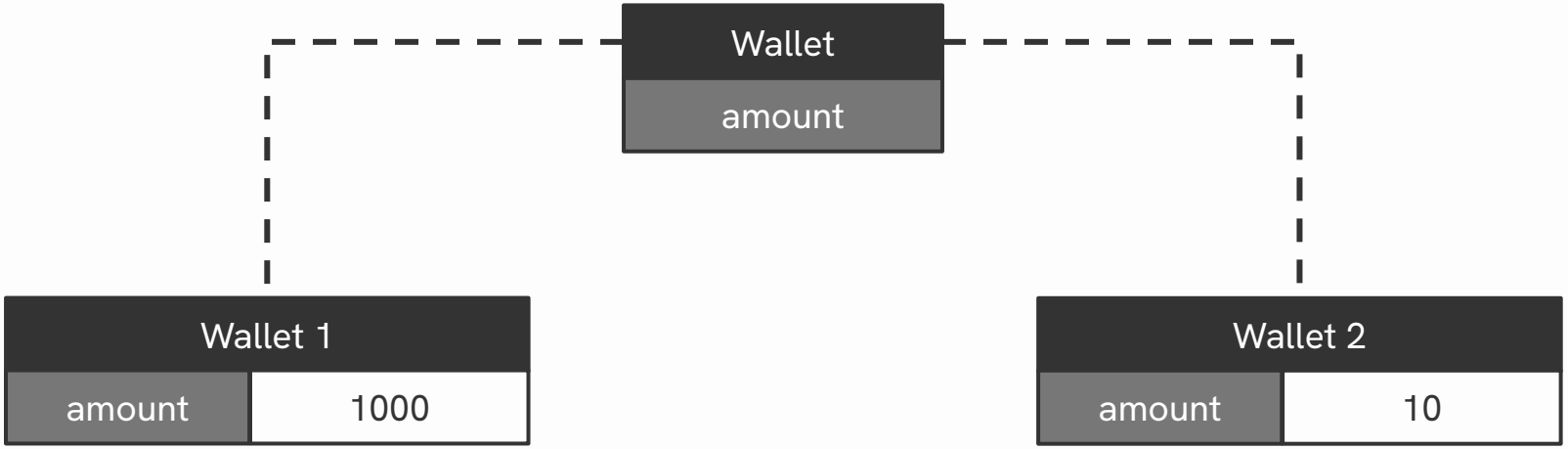



BPI
BPI
Makati Main
OPEN
WELCOME

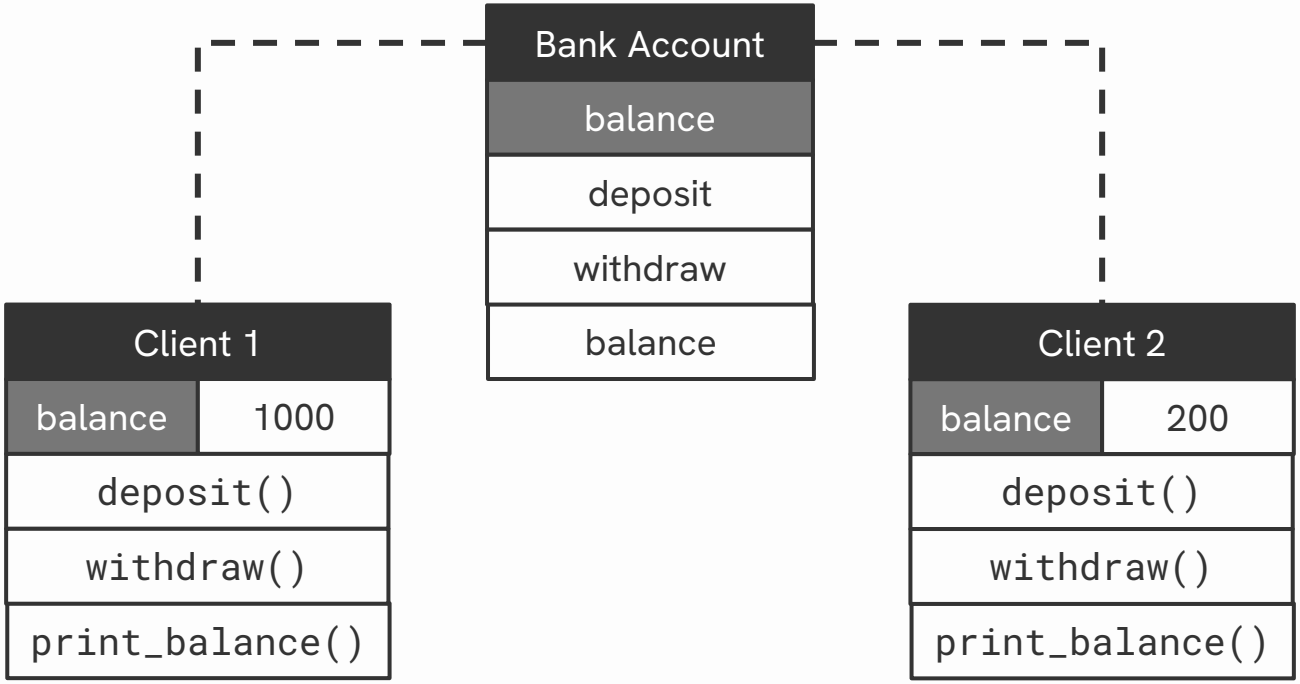
# Book


Book
title
genre
author
Book 1
title
The Hobbit
genre
Fantasy
author
J.R.R. Tolkien
Book 2
title
Dune
genre
Sci-Fi
author
Frank Herbert

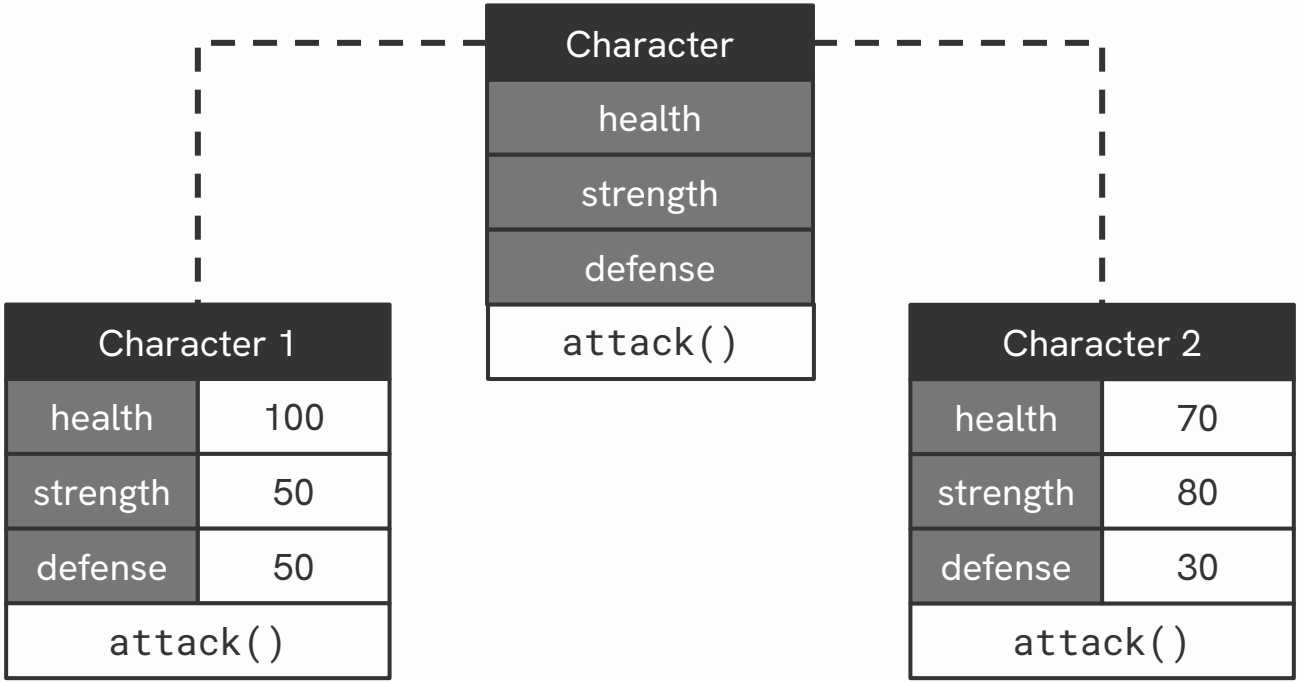
# Wallet

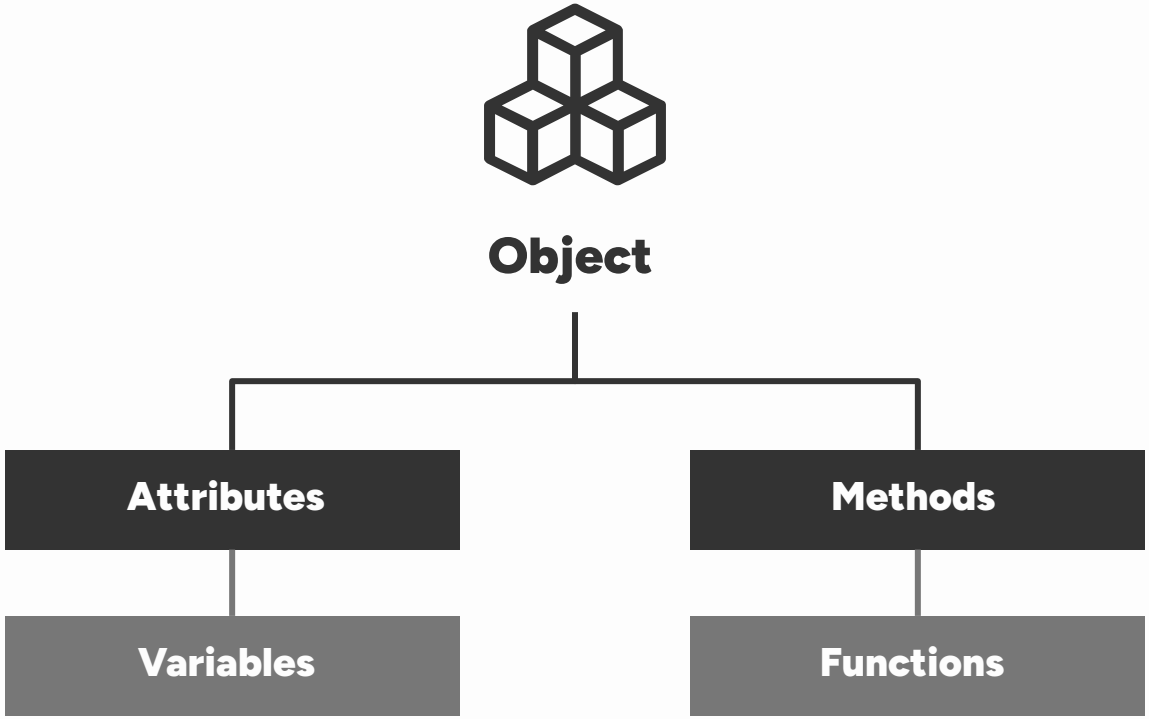


# Bank Account



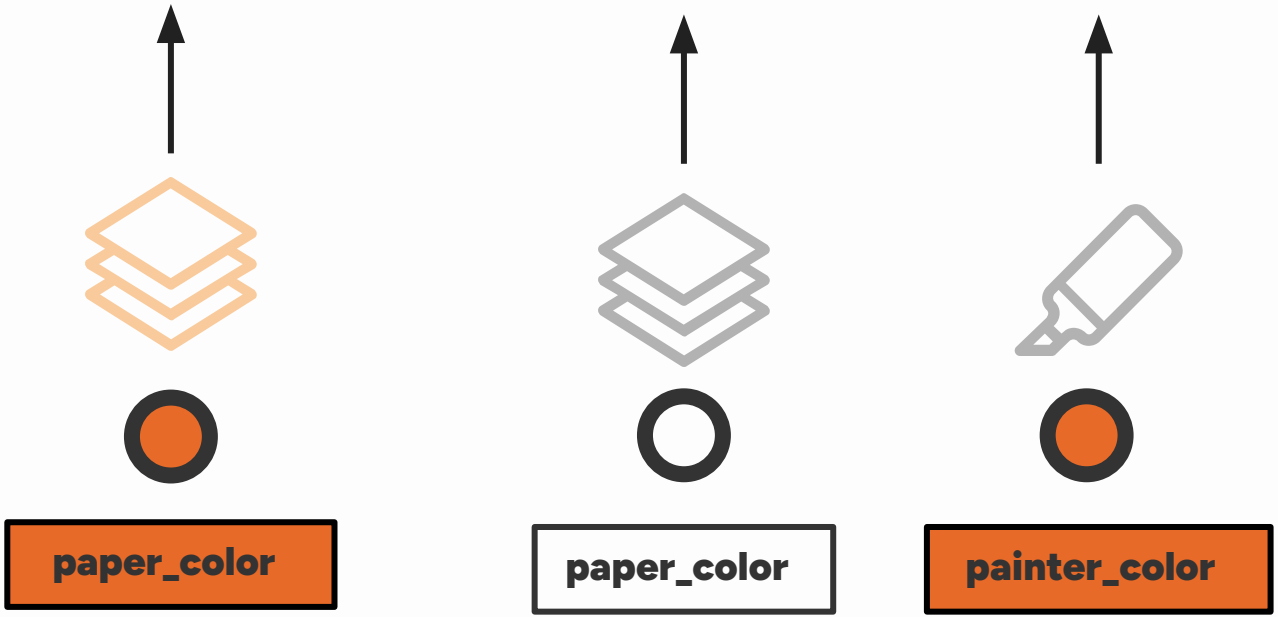
# Game Character




Object
Attributes
Methods
Variables
Functions

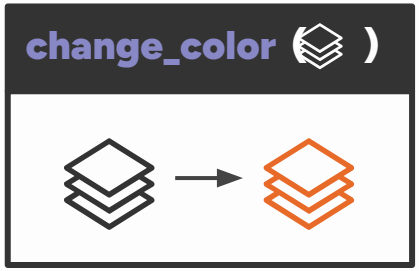
# Functional Approach

```
paper_color = change_color(paper_color, marker_color)
```



# Object Oriented Approach

```
marker.change_color(paper)
```

# Building Exercise

# Example Class

employee.py

```
class Employee:
    """Class representation for employee data"""
```

# Object Creation

employee.py

```
1  class Employee:
2      """Class representation for employee data"""
3
4  employee1 = Employee()
5
6
7
8
9
10
11
12
13
14
15
```

# Multiple Object Creation

employee.py

```
1  class Employee:
2      """Class representation for employee data"""
3
4  employee1 = Employee()
5  employee2 = Employee()
6
7
8
9
10
11
12
13
14
15
```

# Class Constructor

employee.py

```
1  class Employee:
2      """Class representation for employee data"""
3      def __init__(self):
4          print("Employee created")
5
6  employee1 = Employee()
7  employee2 = Employee()
8
9
10
11
12
13
14
15
```

# Class Constructor

employee.py

```
1  class Employee:
2      """Class representation for employee data"""
3      def __init__(self, name):
4          print(f"Employee {name} created")
5
6  employee1 = Employee("Richard")
7  employee2 = Employee("Jelly")
8
9
10
11
12
13
14
15
```

# Class Constructor

employee.py

```
1  class Employee:
2      """Class representation for employee data"""
3      def __init__(self, name, id):
4          print(f"Employee {name} created with ID {id}")
5
6  employee1 = Employee("Richard", "1234")
7  employee2 = Employee("Jelly", "9876")
8
9
10
11
12
13
14
15
```

# Object Attributes

employee.py

```
1  class Employee:
2      """Class representation for employee data"""
3      def __init__(self, name, id):
4          self.name = name
5          self.id = id
6          print(f"Employee {self.name} created with ID {self.id}")
7
8  employee1 = Employee("Richard", "1234")
9  employee2 = Employee("Jelly", "9876")
10
11 print("Employee 1 Name:", employee1.name)
12 print("Employee 2 Name:", employee2.name)
13
14
15
```

# Object Attributes

self .name

employee1 .name

# Object Methods

employee.py

```
1  class Employee:
2      """Class representation for employee data"""
3      def __init__(self, name, id):
4          self.name = name
5          self.id = id
6          self.tasks = []
7          print(f"Employee {self.name} created with ID {self.id}")
8
9      def add_work(self, task):
10         return self.tasks.append(task)
11
12 employee1 = Employee("Richard", "1234")
13 employee2 = Employee("Jelly", "9876")
14
15 print("Employee 1 Name:", employee1.name)
16 print("Employee 2 Name:", employee2.name)
```

# Object Methods

```
employee.add_work(task)
add_work(employee, task)
```

# Object Methods

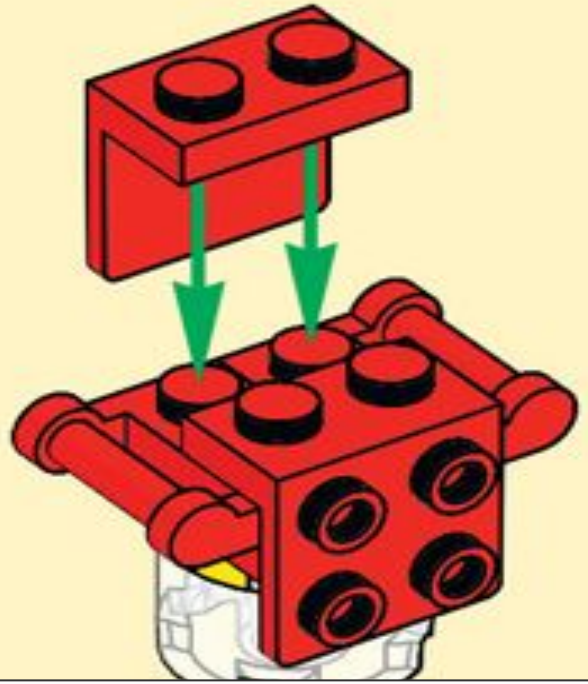
employee.py

```
9       def add_work(self, task):
10          return self.tasks.append(task)
11
12  employee1 = Employee("Richard", "1234")
13  employee2 = Employee("Jelly", "9876")
14
15  print("Employee 1 Name:", employee1.name)
16  print("Employee 2 Name:", employee2.name)
17
18  employee1.add_work("Create Slides")
19  employee1.add_work("Present report")
20
21  print("Employee 1 Tasks:", employee1.tasks)
22  print("Employee 2 Tasks:", employee2.tasks)
```

1

H1

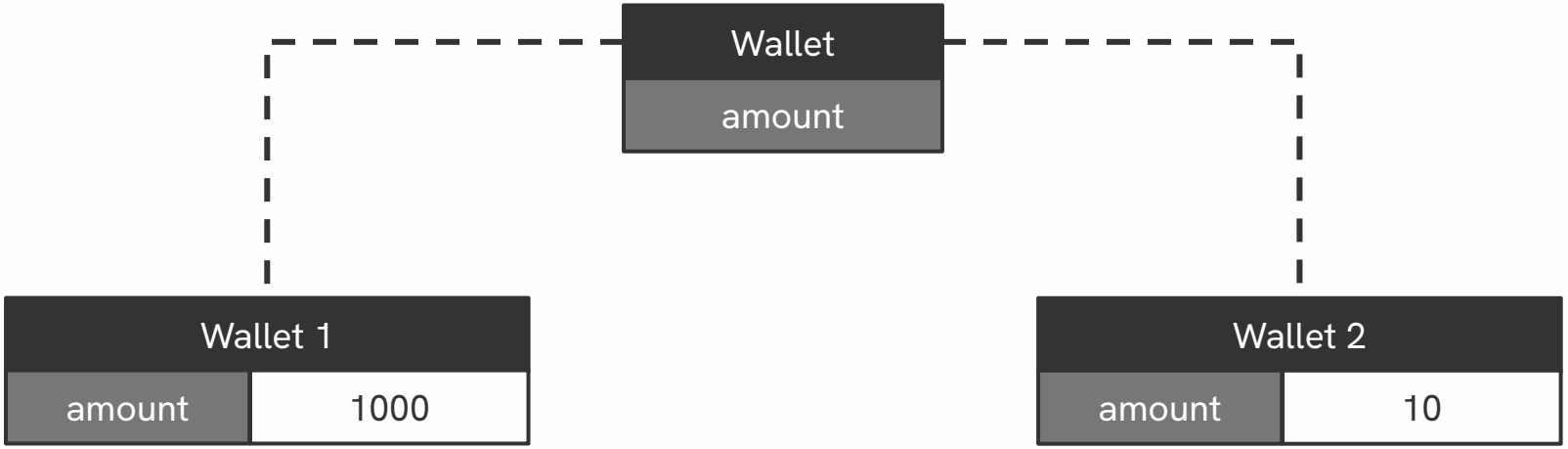
4



# Hands-On Building

2

# Wallet

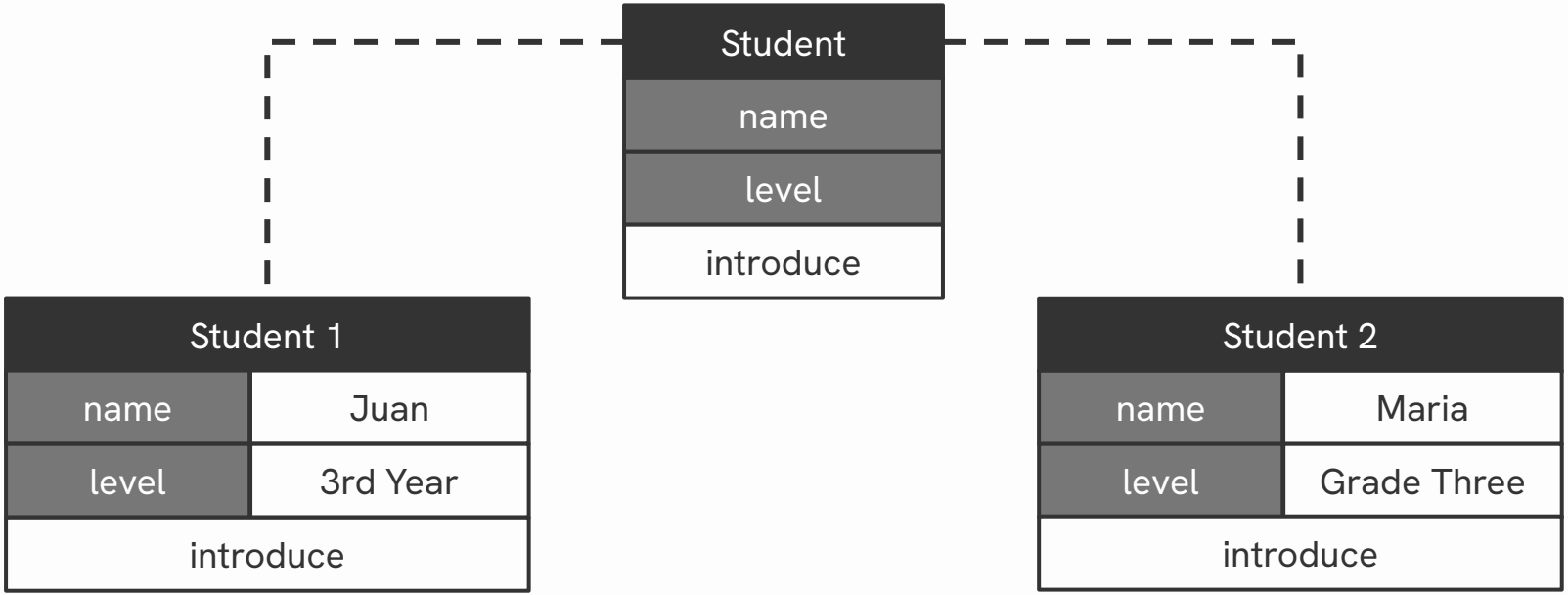


# Implement : Wallet

wallet.py

```
1  class Wallet:
2      def __init__(self, initial_amount=0):
3          self.amount = initial_amount
4
5  food_wallet = Wallet(250)
6  food_wallet.amount += 1_000
7
8  print("Food Budget:", food_wallet.amount)
```

# Student

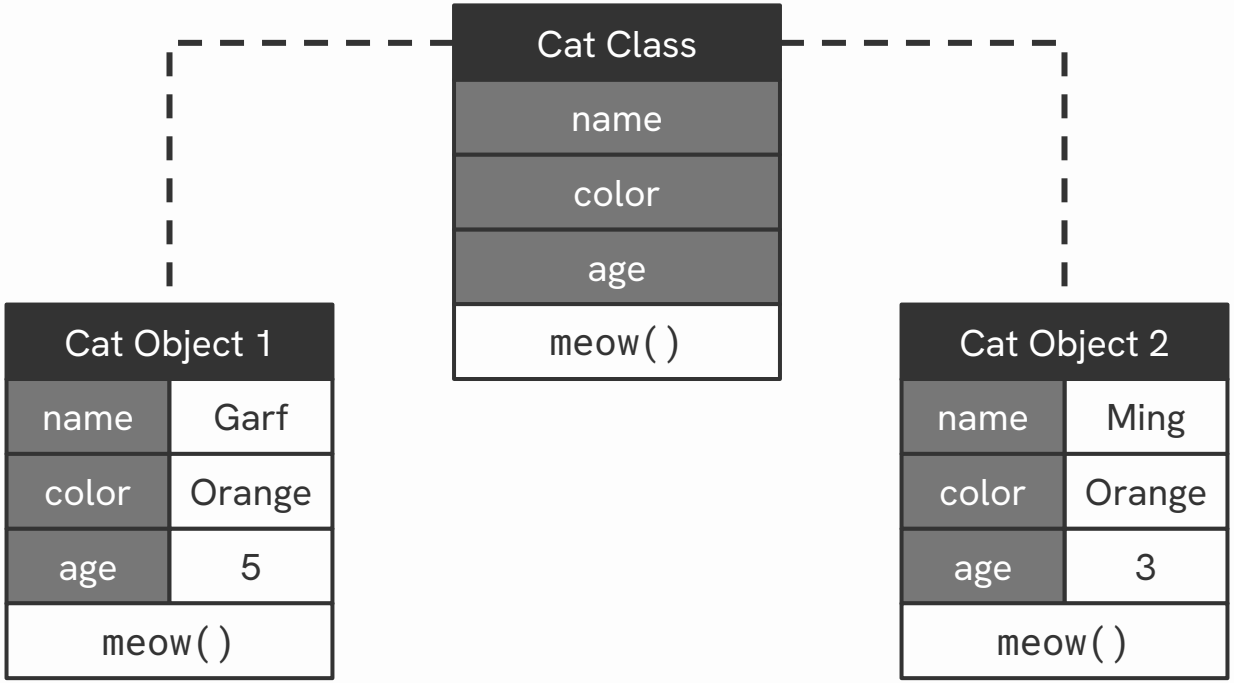

Student
name
level
introduce
Student 1
name
Juan
level
3rd Year
introduce
Student 2
name
Maria
level
Grade Three
introduce

# Implement : Student

student.py

```
1  class Student:
2      def __init__(self, name, level):
3          self.name = name
4          self.level = level
5
6      def introduce(self):
7          return f"I'm {self.name}! I'm a {self.level} student."
8
9  student1 = Student("Juan", '3rd Year College')
10 print(student1.introduce())
11
12 student2 = Student("Maria", 'Grade Three')
13 print(student2.introduce())
```

# Cat

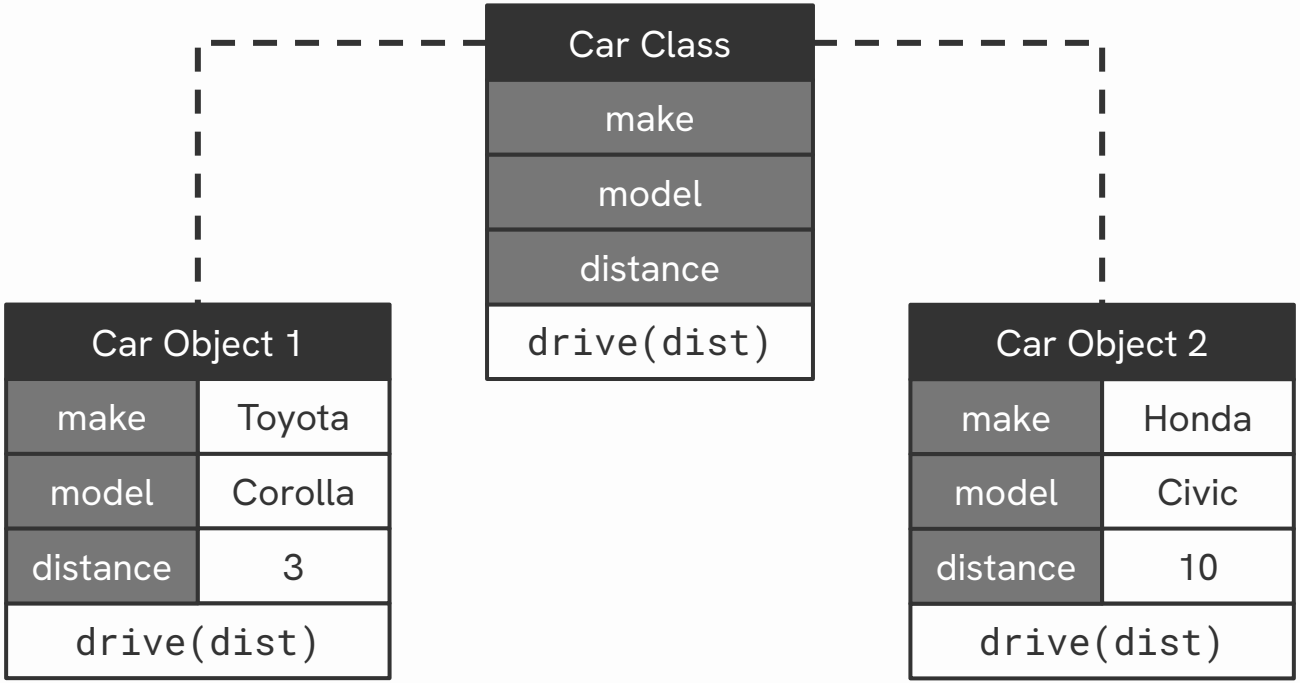

Cat Class
name
color
age
meow()
Cat Object 1
name
Garf
color
Orange
age
5
meow()
Cat Object 2
name
Ming
color
Orange
age
3
meow()

# Implement : Cat

cat.py

```
1  class Cat:
2      meows = 0
3      def __init__(self, name, color, age):
4          self.name = name
5          self.color = color
6          self.age = age
7      def meow(self):
8          print("Meow")
9          Cat.meows += 1
10
11 cat_1 = Cat("Garf","Orange", 5)
12 cat_1.meow()
13 cat_2 = Cat("Ming","Orange", 3)
14 cat_2.meow()
15
16 print(Cat.meows)
```

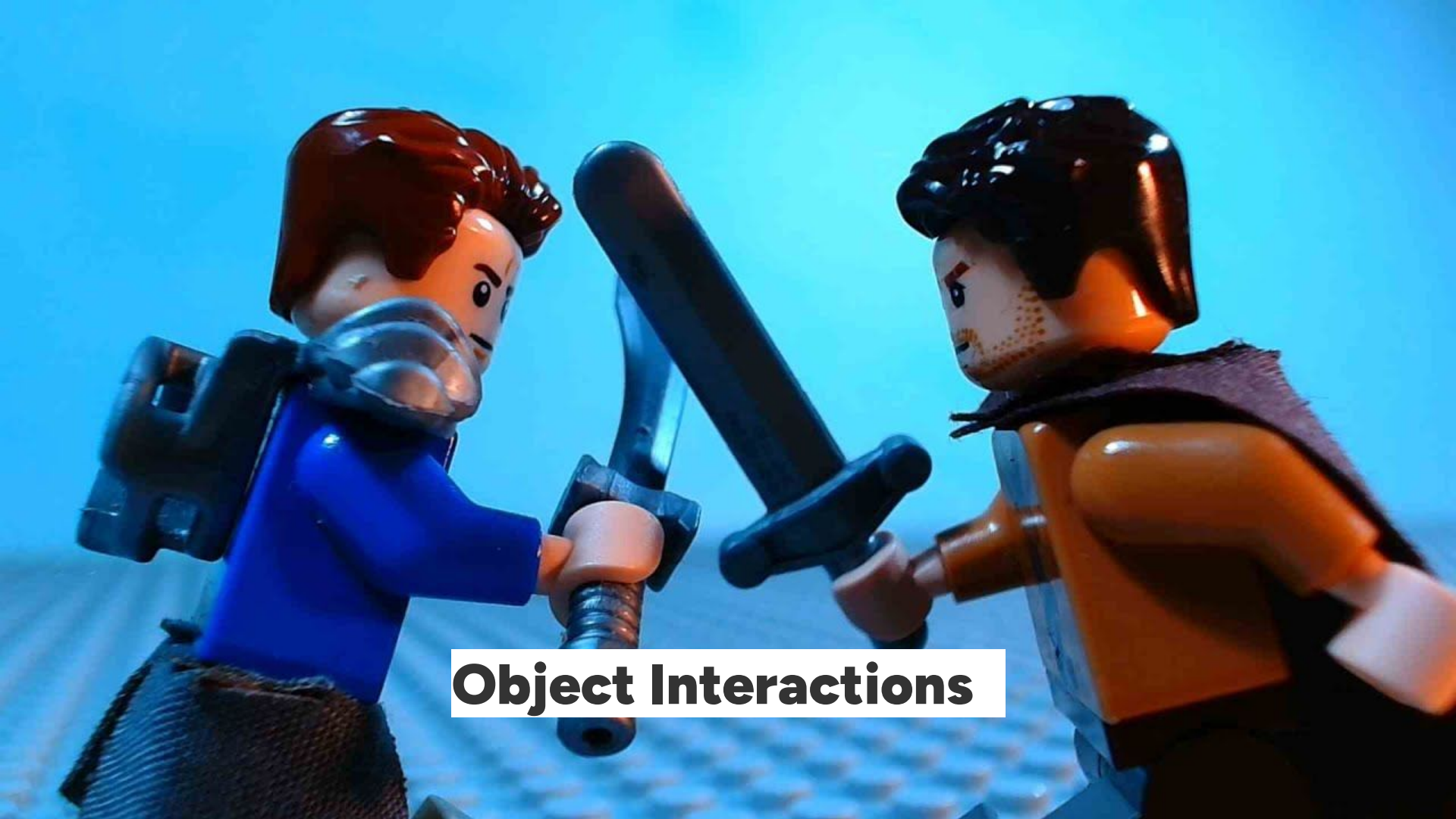
# Car


Car Class
make
model
distance
drive(dist)
Car Object 1
make
Toyota
model
Corolla
distance
3
drive(dist)
Car Object 2
make
Honda
model
Civic
distance
10
drive(dist)

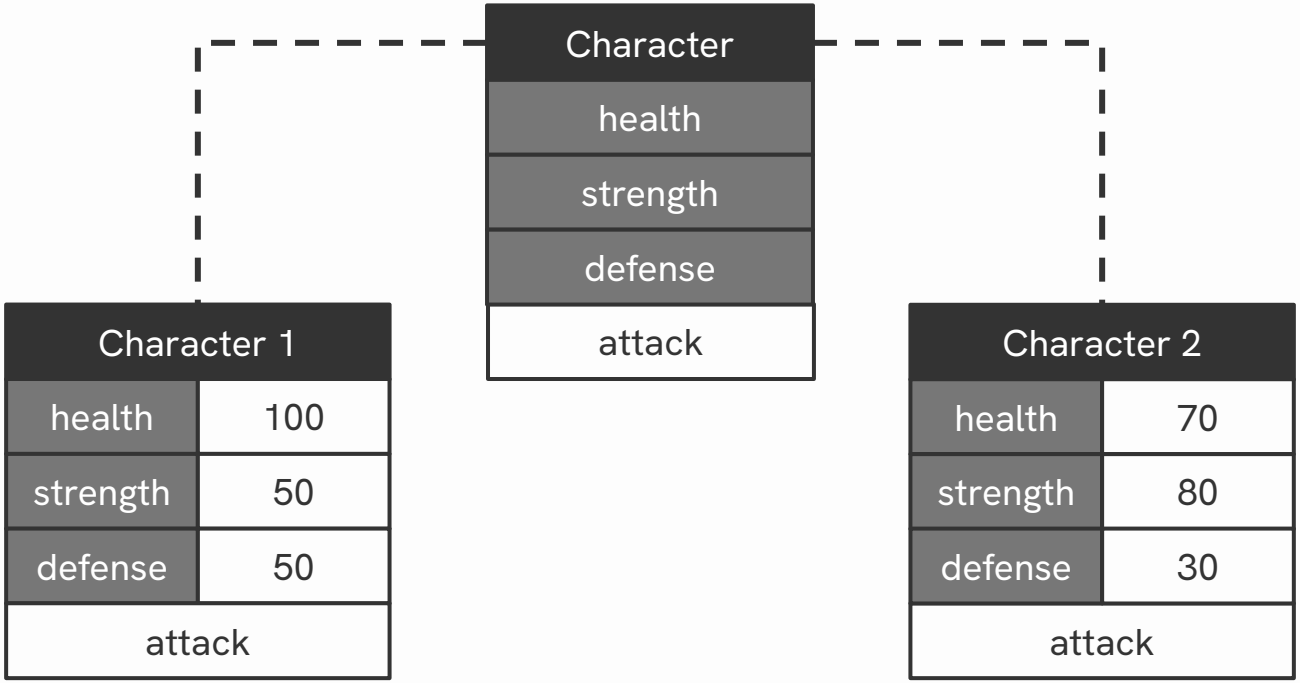
# Implement : Car

car.py

```
1  class Car:
2       distance = 0
3       def __init__(self):
4            self.make = make
5            self.model = model
6            self.distance = 0
7       def drive(self, dist):
8            self.distance += dist
9            Car.total_distance += dist
10
11 car_1 = Car("Toyota","Corolla")
12 car_1.drive(3)
13
14 car_2 = Car("Honda","Civic")
15 car_2.drive(10)
16
17 print(car_1.distance)
18 print(car_2.distance)
19 print(Car.distance)
```


Object Interactions

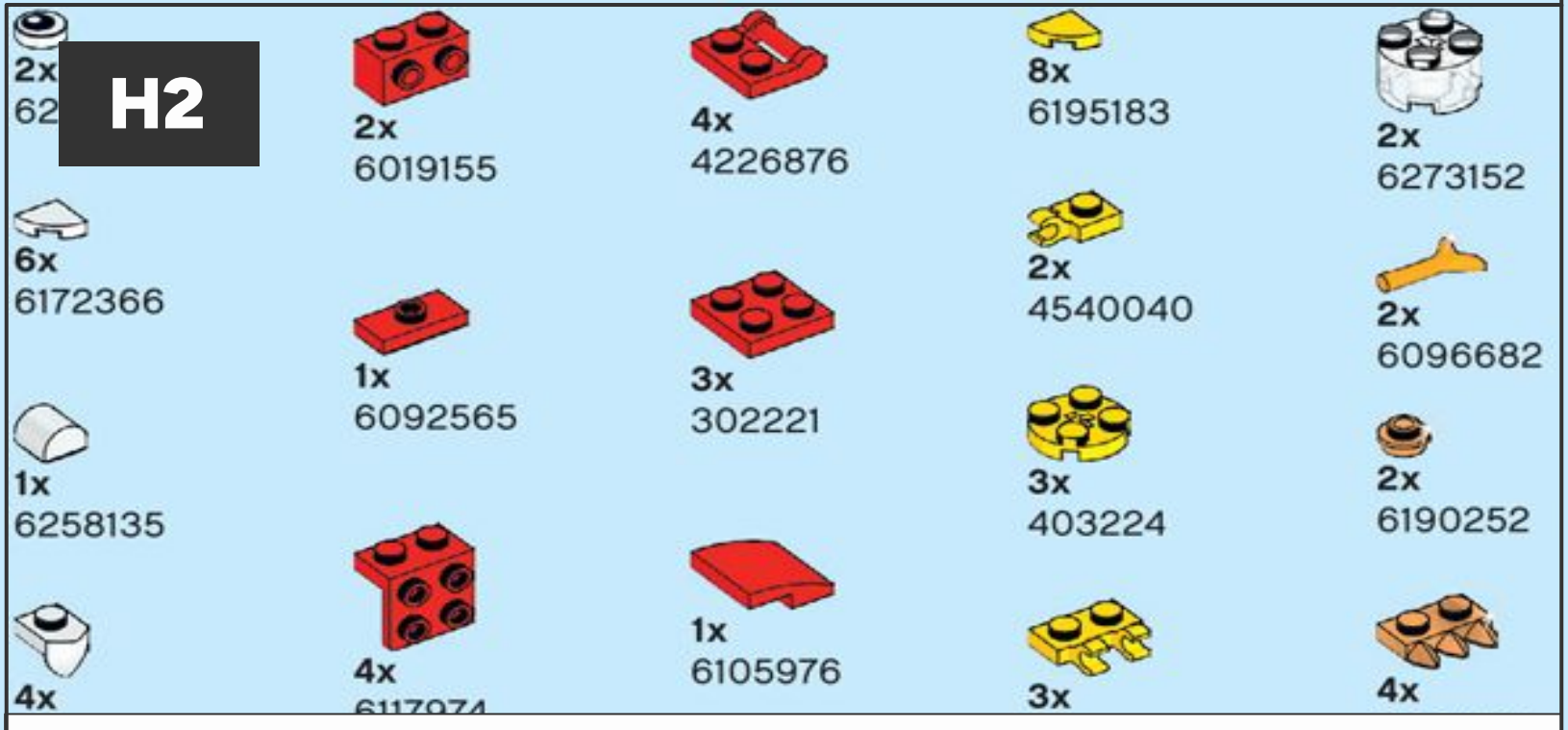
# Game Character



# Implement: Character

character.py

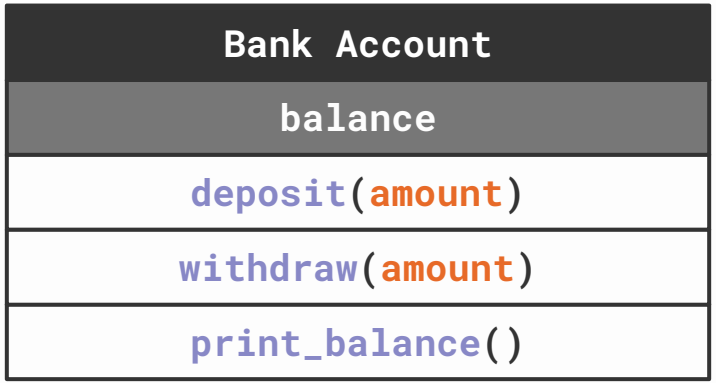
```
1  class Character:
2      def __init__(self, health=10, strength=10, defense=10):
3          self.health = health
4          self.strength = strength
5          self.defense = defense
6
7      def attack(self, other):
8          damage = self.strength - other.defense
9          other.health -= damage
10
11 player = Character(strength=100)
12 enemy = Character()
13
14 player.attack(enemy)
15 print(enemy.health)
```




H2

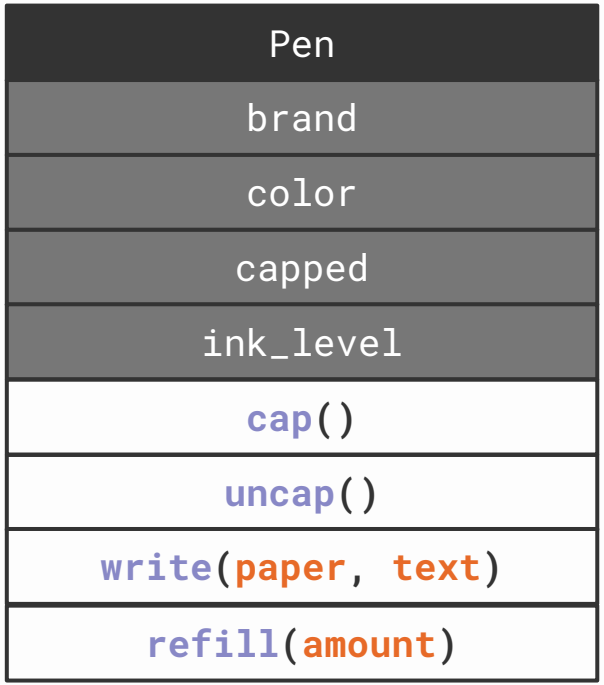
# Hands-Off Building

# Implement: Bank Account




bank_account.py

# Challenge: Pen and Paper





writing.py

02

# Hierarchy

Reducing redundancy in classes

# Inheritance

Explicit class structure

# Code Redundancy

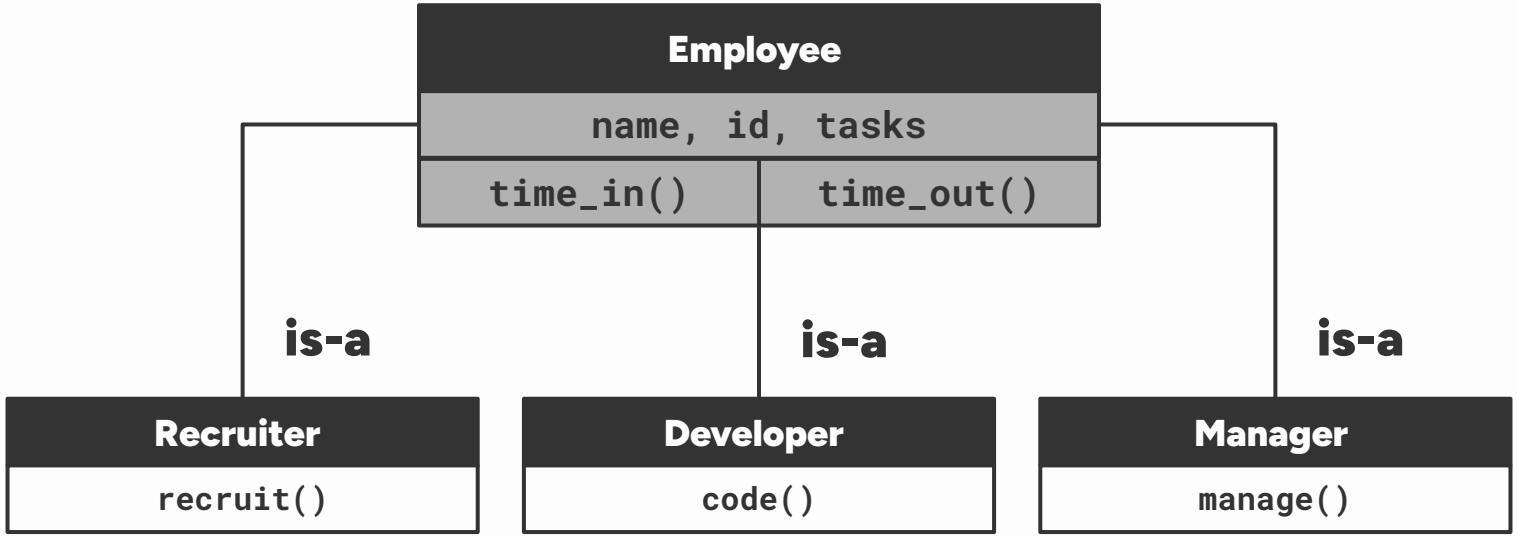
```
class Recruiter:
    def __init__(self, id)
        ...
    def time_in(self): ...
    def time_out(self): ...
    def recruit(self): ...
```

```
class Designer:
    def __init__(self, id):
        ...
    def time_in(self): ...
    def time_out(self): ...
    def design(self): ...
```

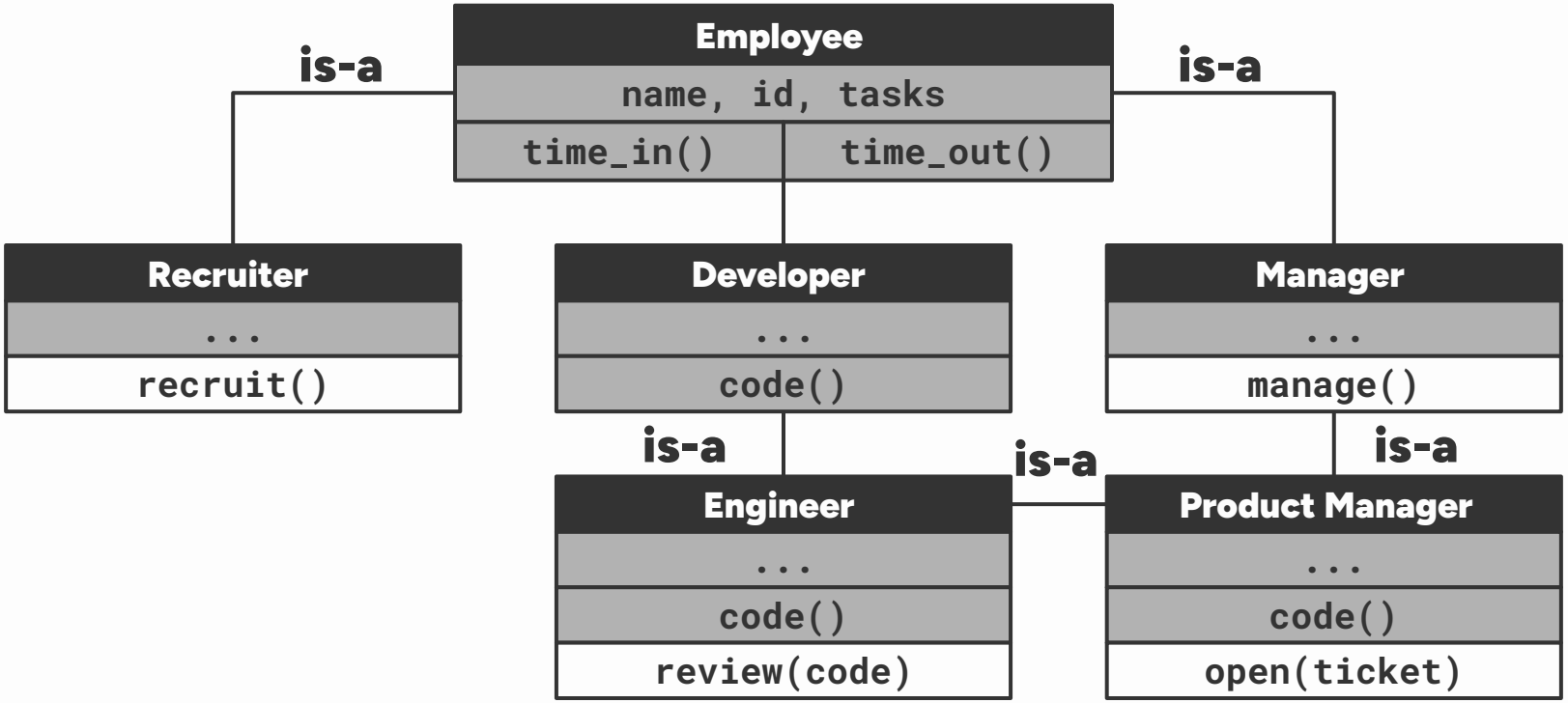
```
class Developer:
    def __init__(self, id):
        ...
    def time_in(self): ...
    def time_out(self): ...
    def code(self): ...
```

```
class Manager:
    def __init__(self, id):
        ...
    def time_in(self): ...
    def time_out(self): ...
    def manage(self): ...
```

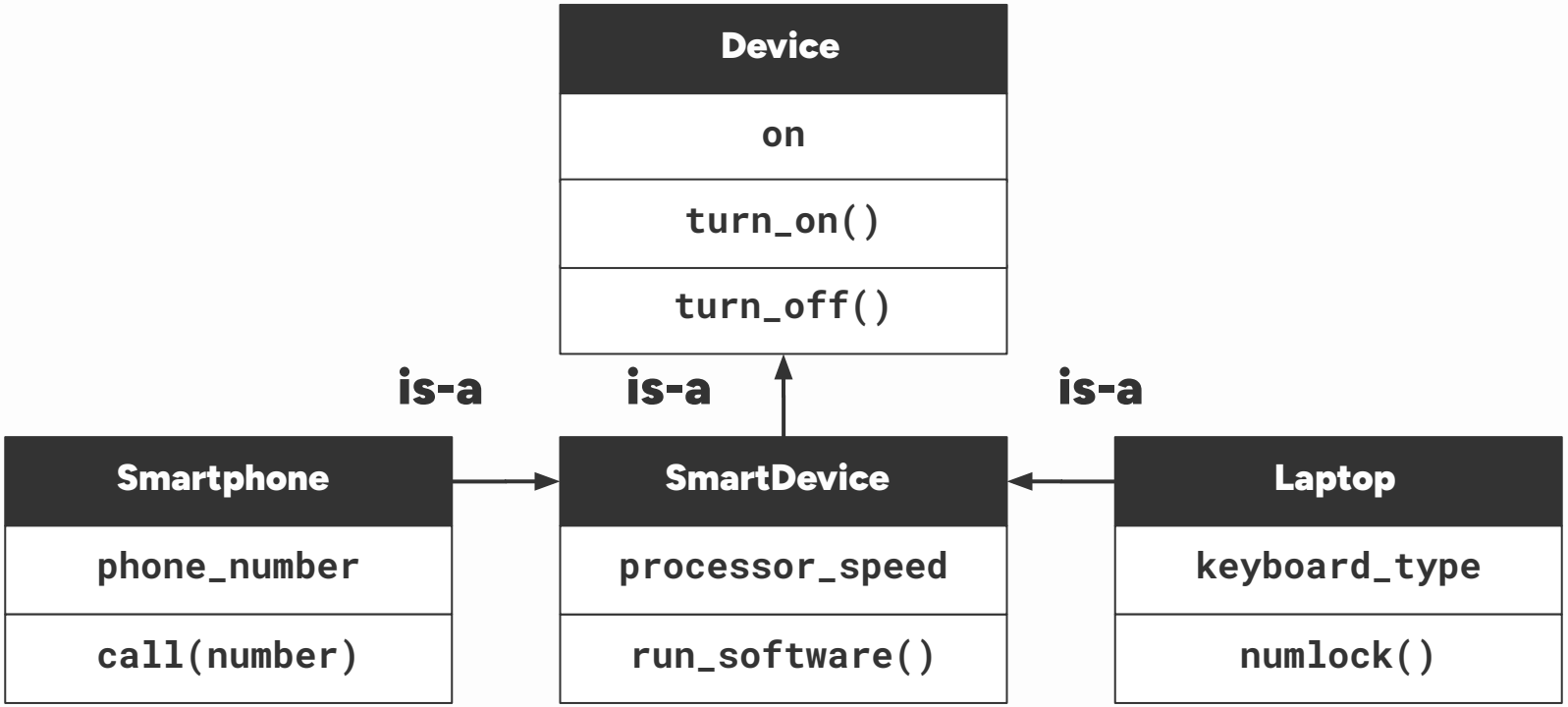
# Hierarchy


Employee
name, id, tasks
time_in()
time_out()
is-a
is-a
is-a
Recruiter
recruit()
Developer
code()
Manager
manage()

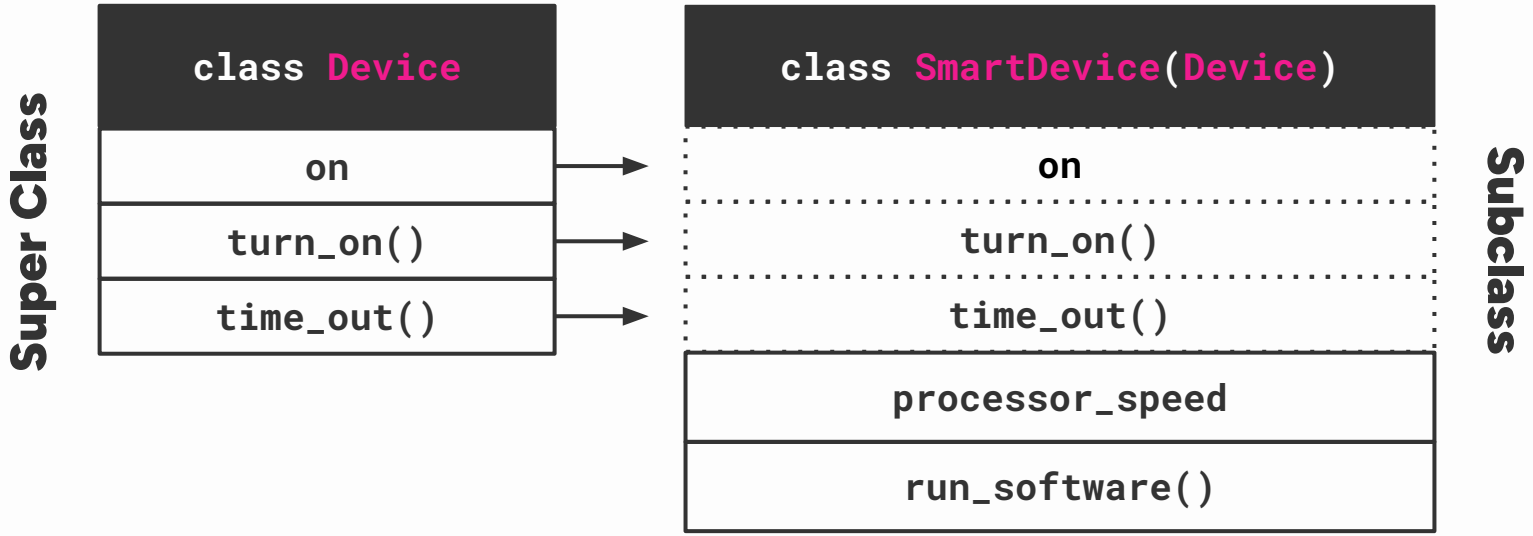
# Hierarchy (Complex)



# Hierarchy


Device
on
turn_on()
turn_off()
is-a
is-a
is-a
Smartphone
phone_number
call(number)
SmartDevice
processor_speed
run_software()
Laptop
keyboard_type
numlock()

# Class Inheritance

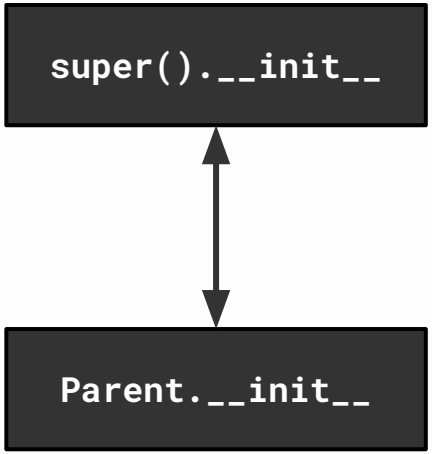


# Inheritance Format

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

```
class Student(Person):
    def __init__(self, first_name, last_name, level):
        super().__init__(first_name, last_name)
        self.level = level
```

```
class Student(Parent):
    def __init__(self, likes, toys):
        self.first_name = first_name
        self.last_name = last_name
        self.level = level
```



# Implement: Student Class

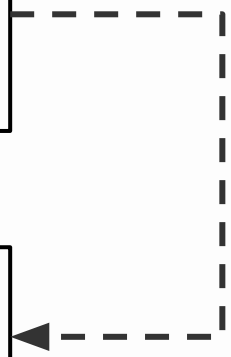
student.py

```
class Person:
    def __init__(self, first_name, last_name):
        self.first_name = first_name
        self.last_name = last_name
    def sleep(self):
        print("I will sleep for eight hours")
    def introduce(self):
        return f"I'm {self.first_name} {self.last_name}!"

class Student(Person):
    def __init__(self, first_name, last_name, level):
        super().__init__(first_name, last_name)
        self.level = level
    def introduce(self):
        return super().introduce() + f" I'm a {self.level} student."
```

# Silent Inheritance

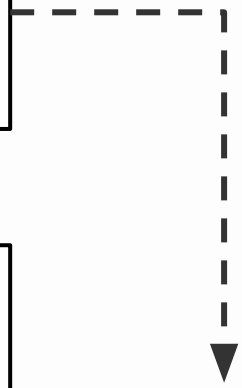
```
class Person:
    def sleep(self):
        print("I will sleep for eight hours")
```

```
class Student(Parent):
    def sleep(self):
        print("I will sleep for eight hours")
```



# Overriding

```
class Person:
    def sleep(self):
        print("I will sleep for eight hours")
```



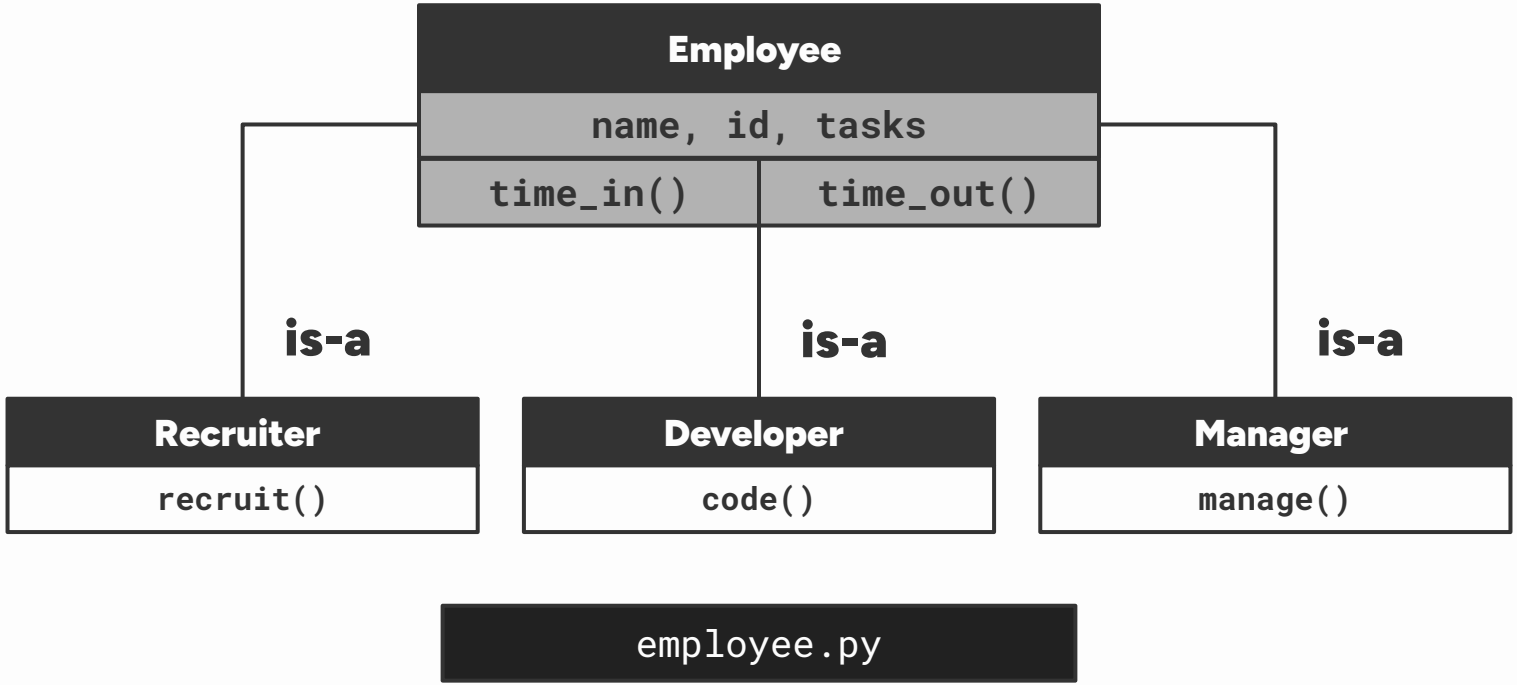
```
class Student(Parent):
    def sleep(self):
        print("I will sleep for six hours")
```

# Example: Writer

user.py

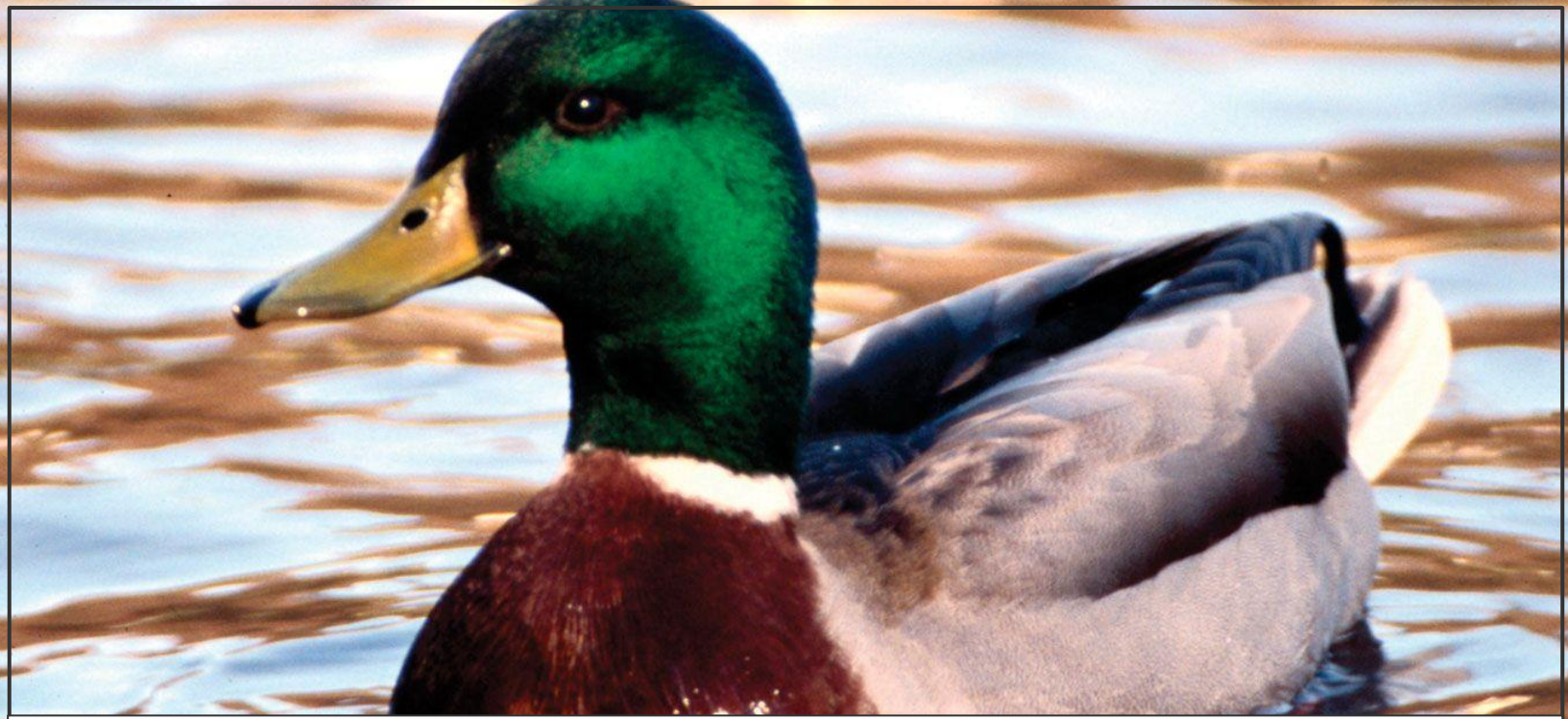
```
class User:
    def __init__(self, username, email):
        self.username = username
        self.email = email

    def display_info(self):
        return f"User: {self.username} Email: {self.email}"

class Writer(User):
    def __init__(self, username, email, articles):
        super().__init__(username, email)
        self.articles = articles

    def write_article(self, title):
        print(f"{self.username} is writing '{title}'...")
        self.articles += 1
```

# Implement: Hierarchy

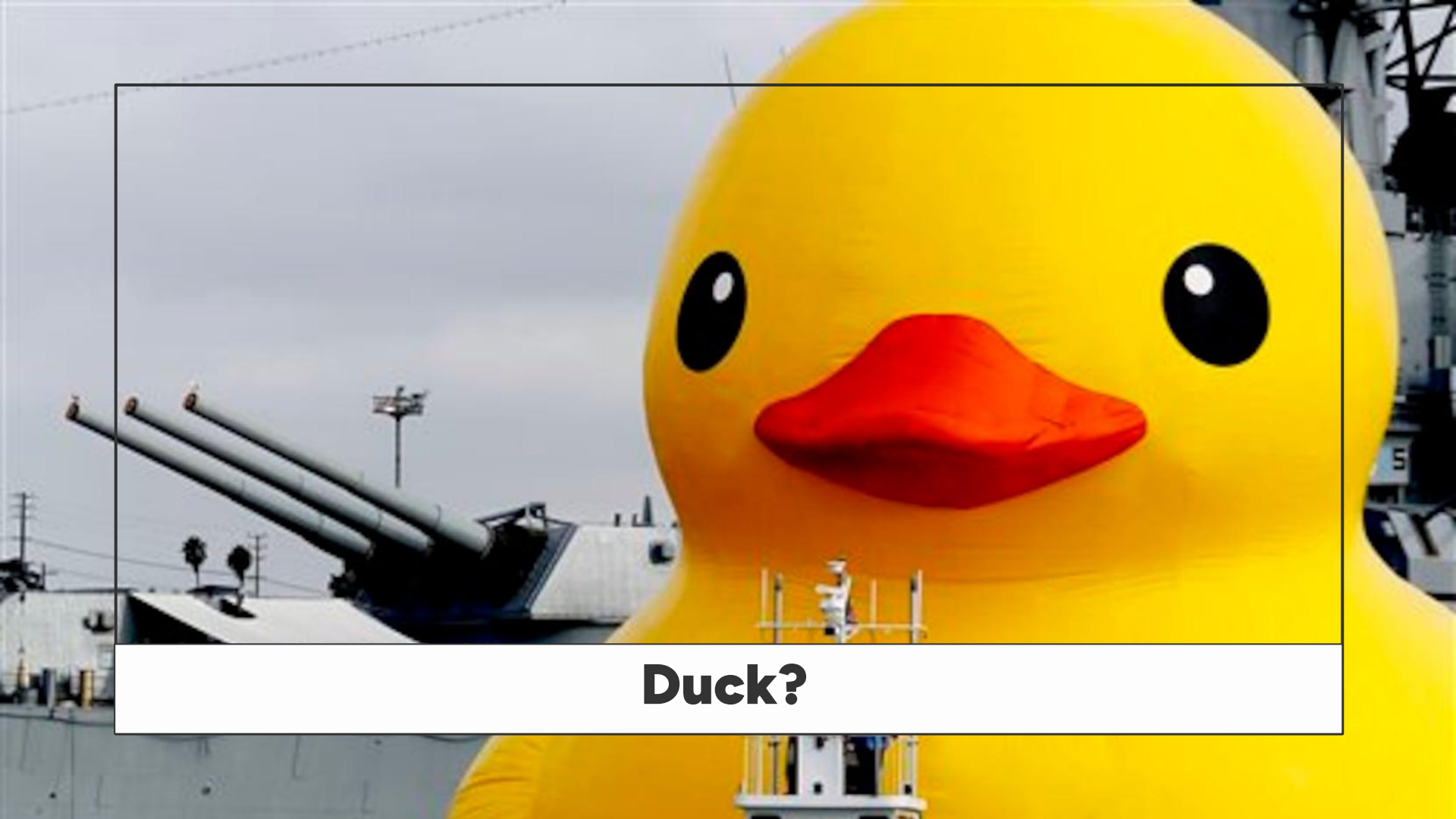


# Duck Typing

Informal Polymorphism



Duck?


Duck?

Duck?

Duck?

""If it looks like a duck, swims like a duck, and quacks like a duck, then it probably is a duck.""

**—Duck Typing**

**Has → Is**

# Implement: Ducks

ducks.py

```
class Duck:
    def __init__(self, beak):
        self.beak = beak
    def swim(self):
        print("Swimming")
    def quack(self):
        print("Quack")
```

```
class RubberDuck:
    def __init__(self, beak):
        self.beak = beak
    def swim(self):
        print("Splish Splosh")
    def quack(self):
        print("Squeak Quack")
```

```
class DuckPerson:
    def __init__(self, beak):
        self.beak = beak
    def swim(self):
        print("Swim hehe!")
    def quack(self):
        print("Quack hehe")
```

```
class RoastedDuck:
    def __init__(self, serving):
        self.serving = serving
```

# Informal Polymorphism

Objects demonstrate Informal Polymorphism when they have similar function signatures that can react appropriate for their own type

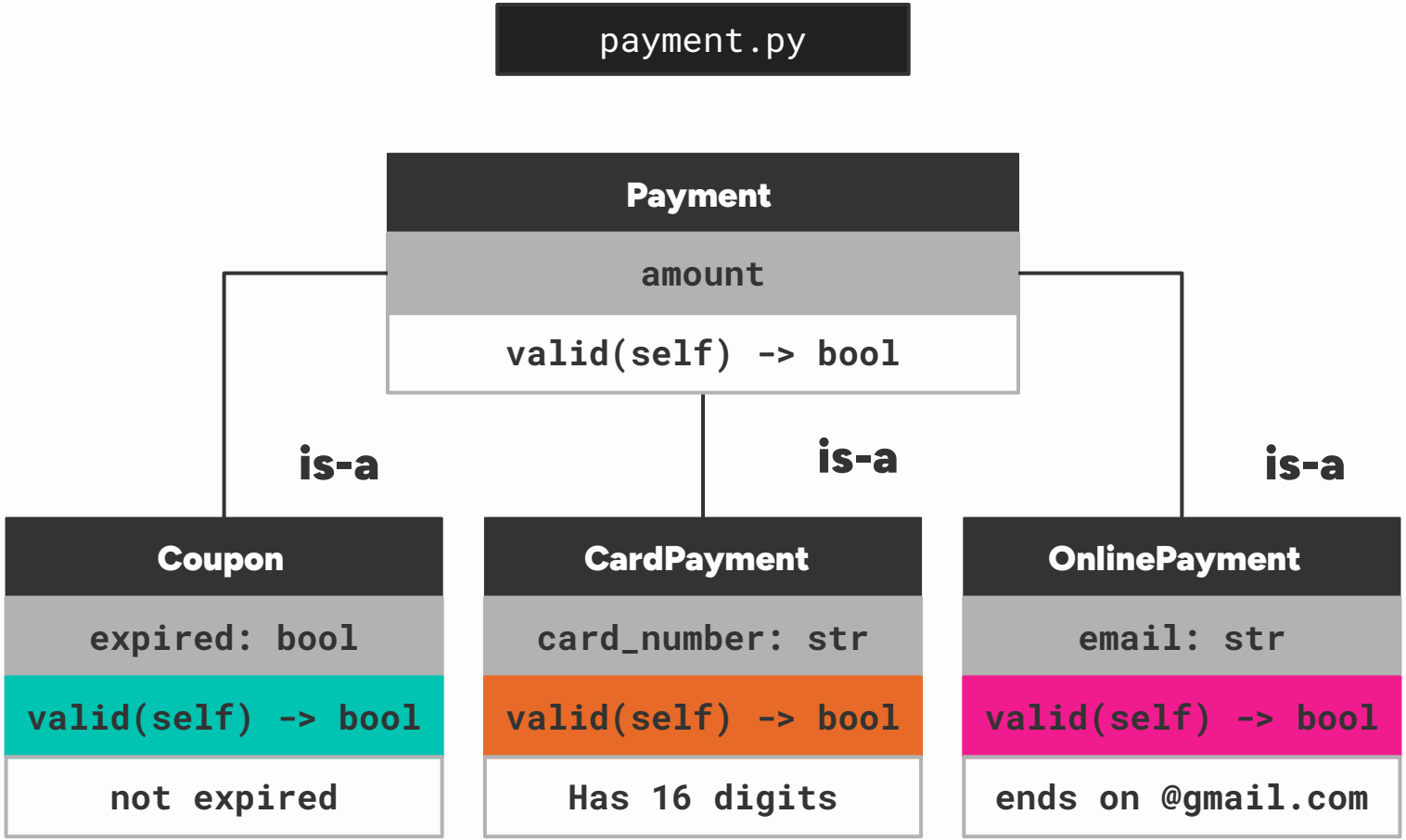
```
ducks = [
    Duck(beak="Real"),
    RubberDuck(beak="Rubber"),
    DuckPerson(beak="Costume"),
]

for duck in ducks:
    duck.quack()
```

# Implement: Knight

character.py

```
 1  class Character:
...      ...
17
18  class Knight:
19      def __init__(self, health=10, defense=10):
20          self.health = health
21          self.defense = defense
22      def attack(self, other):
23          damage = self.defense - other.defense
24          other.health -= damage
25
26  player = Knight(defense=30)
27  enemy = Character()
28  player.attack(enemy)
29  print(enemy.health)
```


H3
Payment Time
Yes, it’s time to pay


payment.py
Payment
amount
valid(self) -> bool
is-a
is-a
is-a
Coupon
expired: bool
valid(self) -> bool
not expired
CardPayment
card_number: str
valid(self) -> bool
Has 16 digits
OnlinePayment
email: str
valid(self) -> bool
ends on @gmail.com

03

# Structure

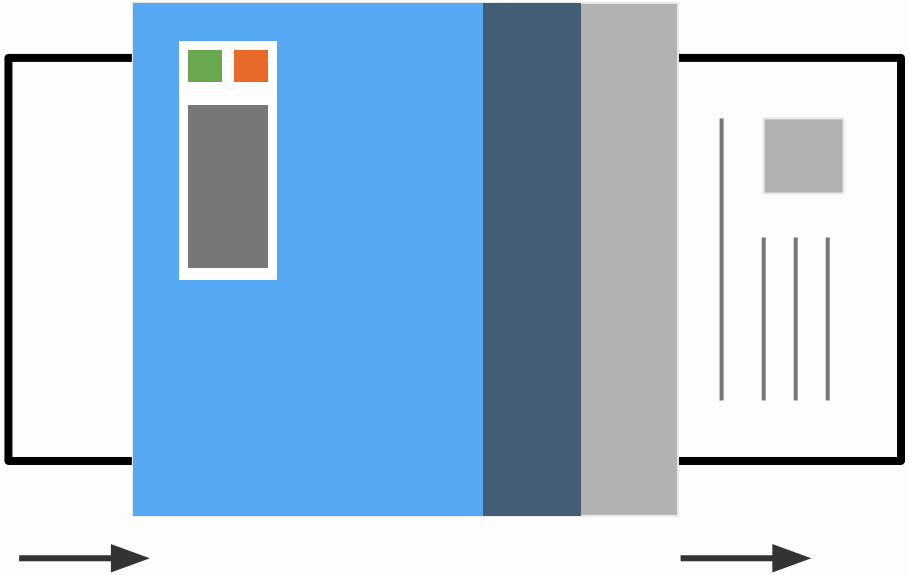
Appropriate Data Representation

# Encapsulation

Manage which parts are accessible to the public

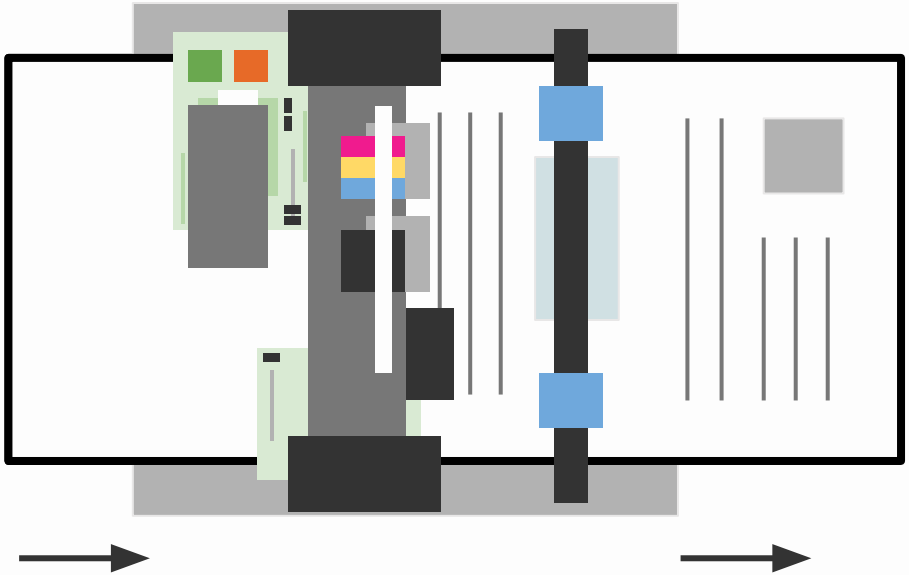
# Strategic Data Hiding

Manage which variables are accessible to the public



# Strategic Data Hiding

Manage which variables are accessible to the public



**Why not show the parts of a printer?**

# Reasons to Encapsulate

## Code Security

Prevent unauthorized read or write operations to sensitive data and processes within the code

## Simplification

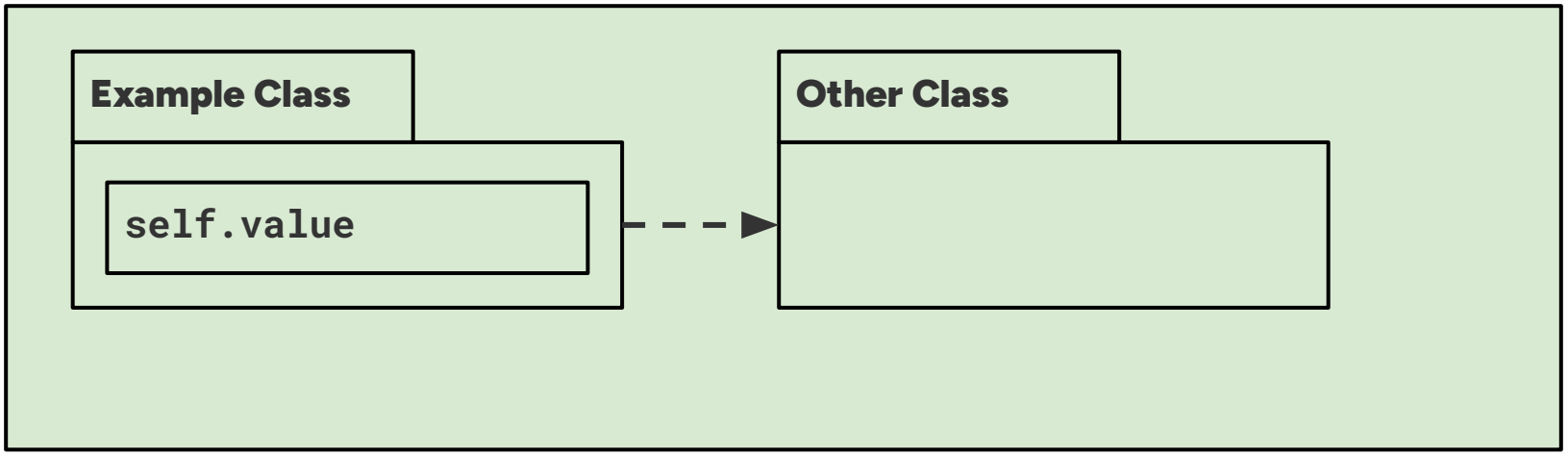
Not every detail of a process needs to be known. Classes can set up their own logic to handle changes

## Maintainability

Less access to data means less suspects when debugging problems or issues when developing

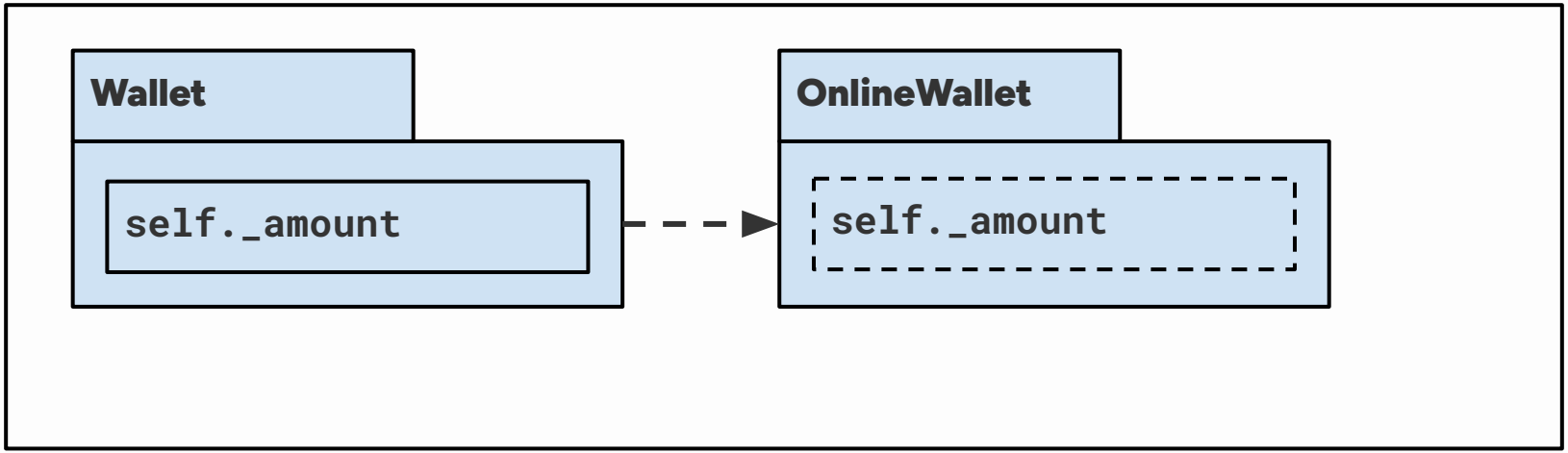
# Public Attribute

```
1 class Counter:
2     def __init__(self):
3         self.value = 0
```



# Protected Attribute

```
1  class Wallet:
2      def __init__(self, initial_amount=0):
3          self._amount = initial_amount
```



# Wallet

```
1  class Wallet:
2      def __init__(self, initial_amount=0):
3          self._amount = initial_amount
4
5  food_wallet = Wallet(250)
6  food_wallet.amount += 1_000
7
8  print("Food Budget:", food_wallet.amount)
```

# Update: Wallet

wallet.py

```
1  class Wallet:
2      def __init__(self, initial_amount=0):
3          self._amount = initial_amount
4
5      def get_amount(self):
6          print(f"Showing amount: {self._amount}")
7          return self._amount
8
9      def set_amount(self, amount):
10         print(f"Setting amount to {amount}")
11         self._amount += amount
12
13 food_wallet = Wallet(250)
14 food_wallet.set_amount(food_wallet.get_amount() + 1_000)
15
16 print("Food Budget:", food_wallet.get_amount())
```

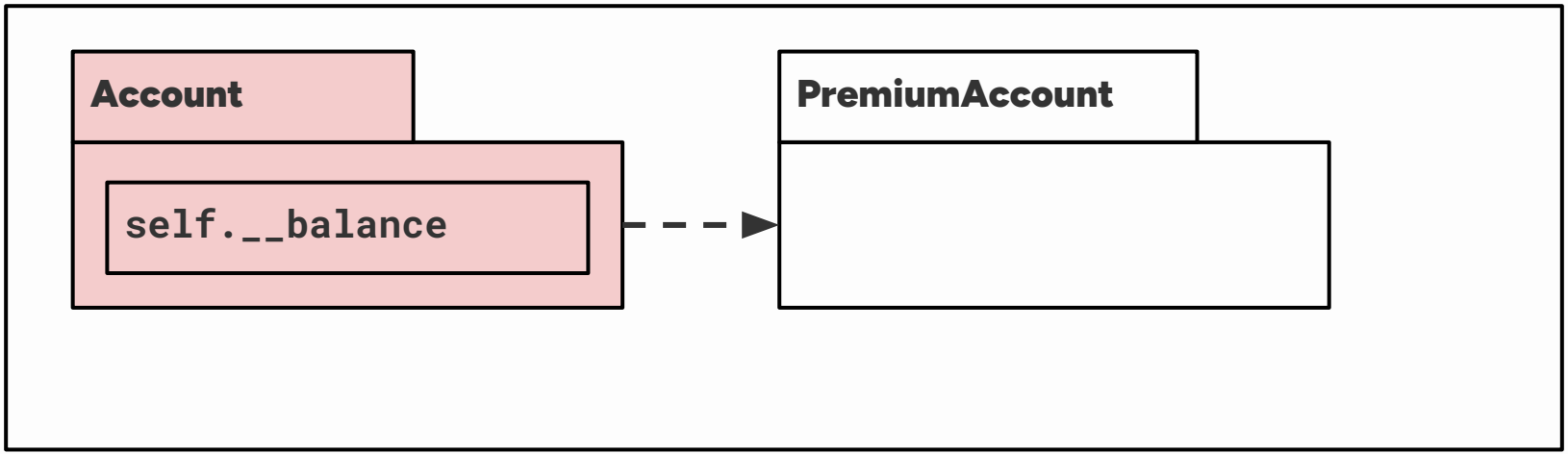
# Update: Wallet

wallet.py

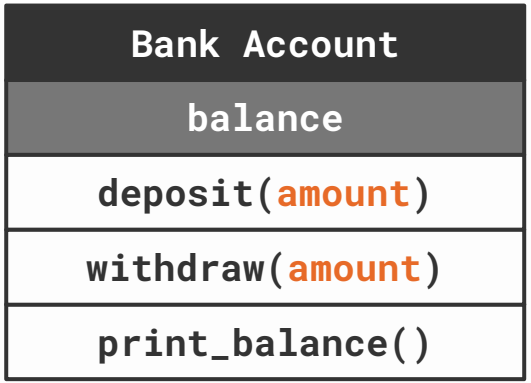
```
1  class Wallet:
2       def __init__(self, initial_amount=0):
3            self._amount = initial_amount
4
5       @property
6       def amount(self):
7            print(f"Showing amount: {self._amount}")
8            return self._amount
9
10      @amount.setter
11      def amount(self, amount):
12           print(f"Setting amount to {amount}")
13           self._amount += amount
14
15 food_wallet = Wallet(250)
16 food_wallet.amount += 1_000
17
18 print("Food Budget:", food_wallet.amount)
```

# Private Attribute

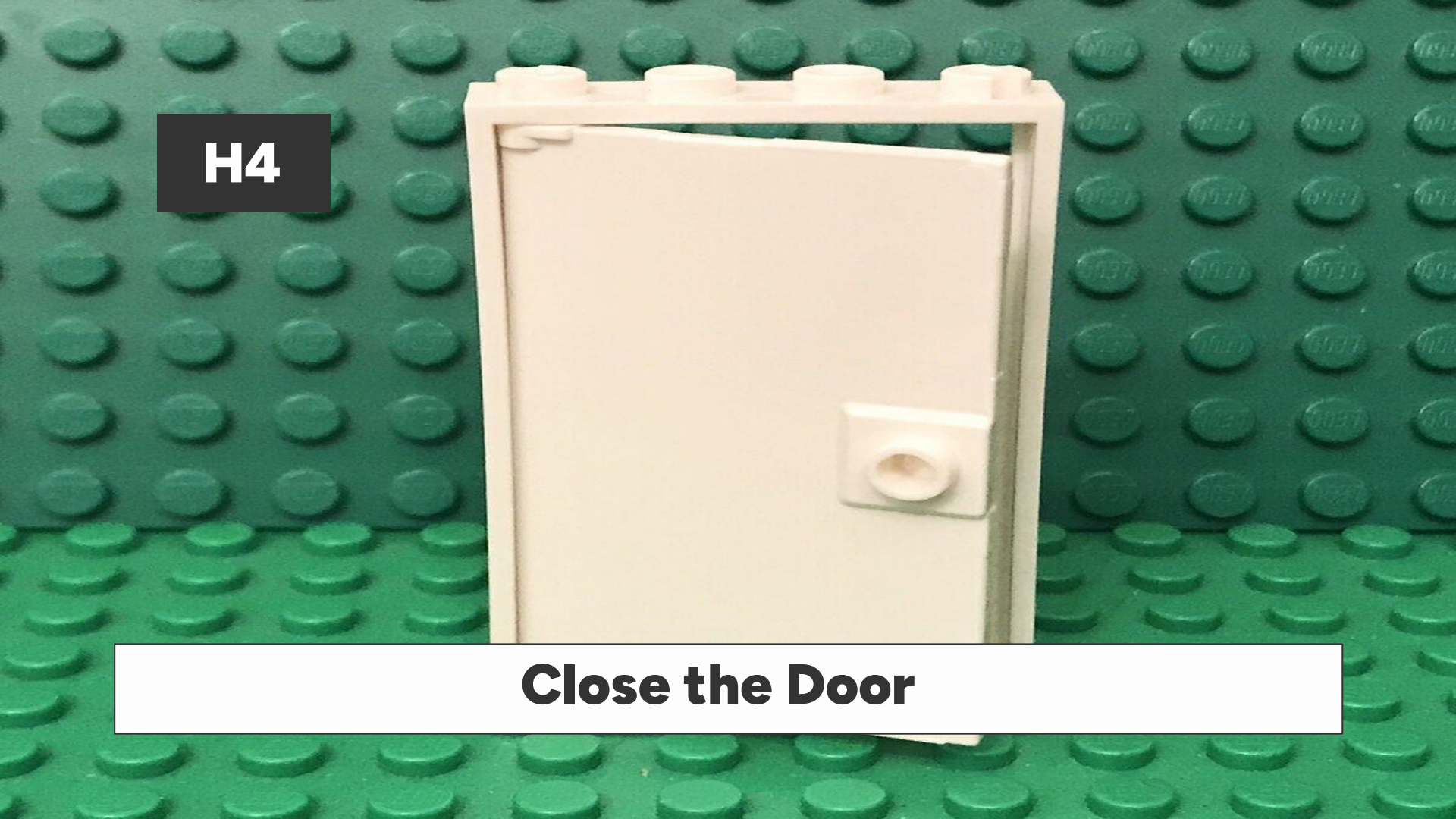
```
1  class Account:
2      def __init__(self, initial_balance=0):
3          self.__balance = initial_balance
```



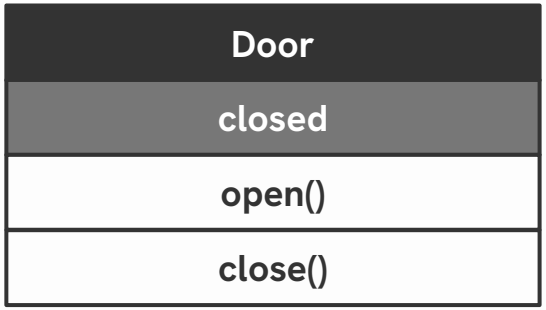
# Refactor: Prevent unnecessary changes




bank_account.py

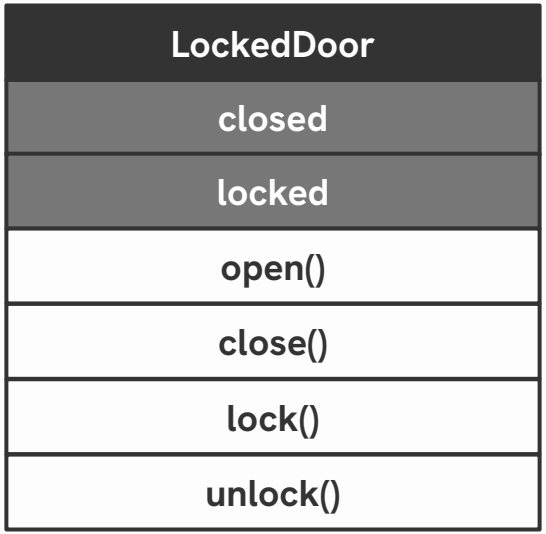

H4
Close the Door

# Implement: Door




door.py

# Challenge: Locked Door

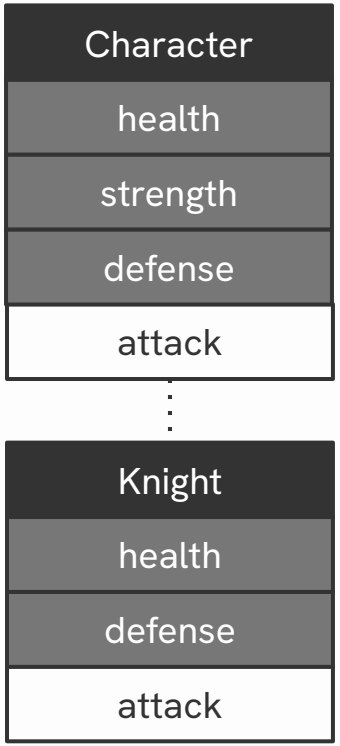



`locked_door.py`

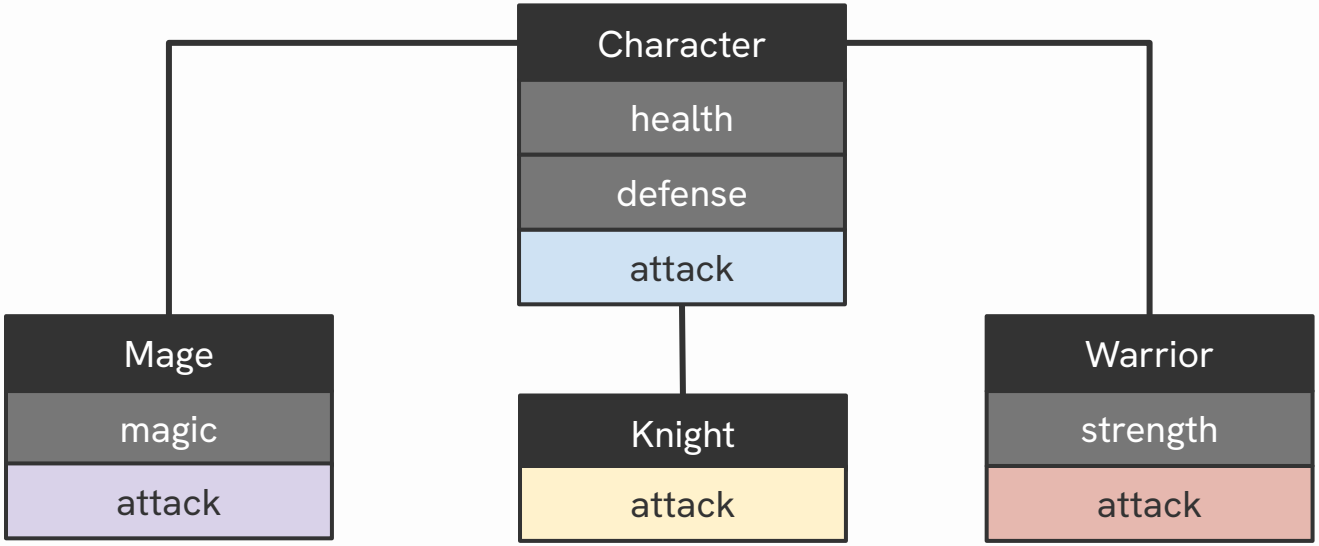
# Abstraction

Contractual Implementation

# Recall: Game Character



# Character Scheme



# Initial Implementation

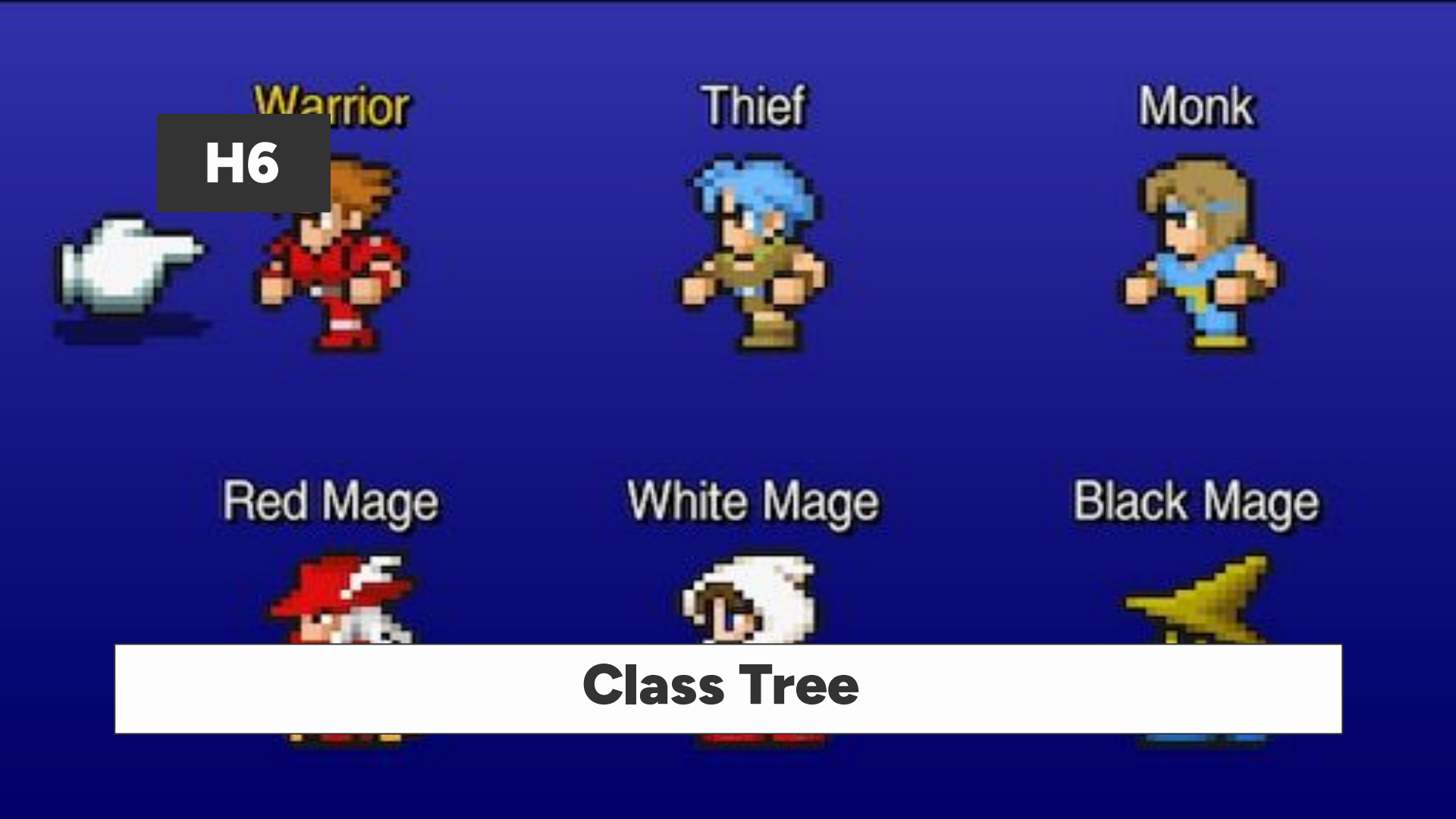
rpg.py

```
1  class Character:
2      def __init__(self, health=10, defense=10):
3          self._health = health
4          self._defense = defense
5      def attack(self, other):
6          raise NotImplementedError()
7
8  class Knight(Character):
9      pass
10
11 enemy = Character()
12 knight = Knight()
13 knight.attack(enemy)
```

# Formal Polymorphism

rpg.py

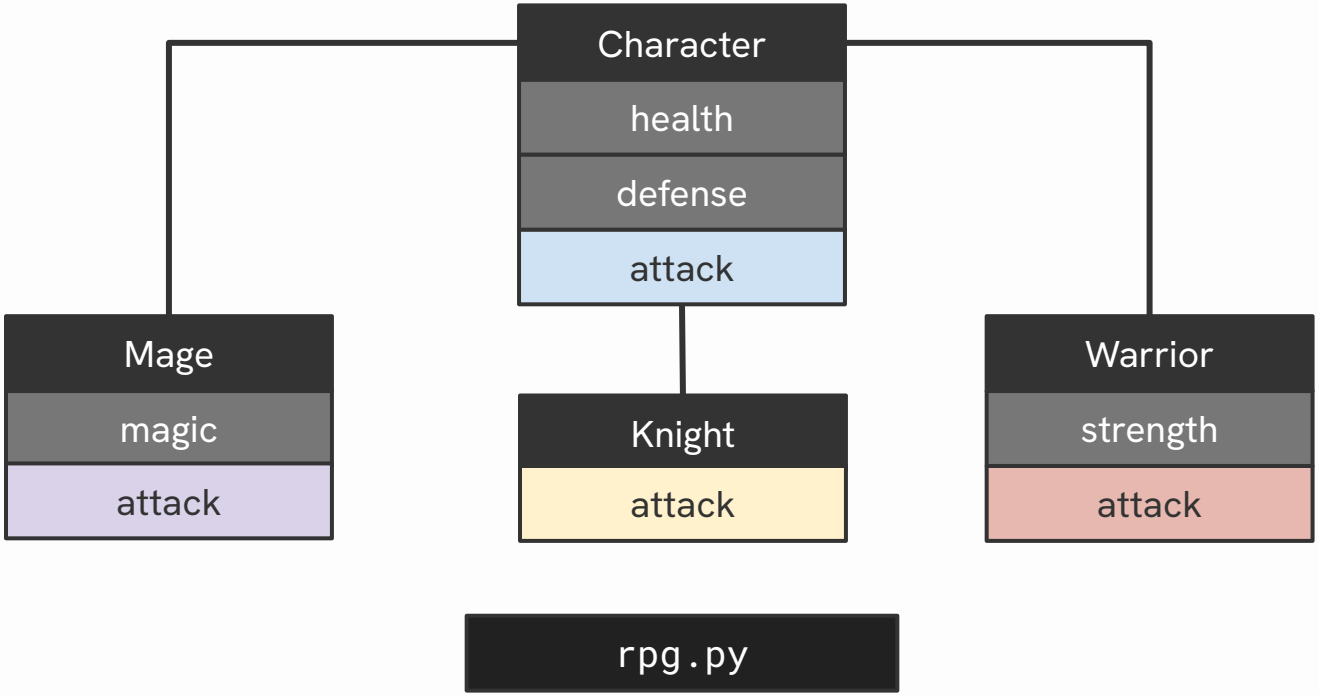
```
1  from abc import ABC, abstractmethod
2
3  class Character(ABC):
4      def __init__(self, health=10, defense=10):
5          self._health = health
6          self._defense = defense
7      @abstractmethod
8      def attack(self, other):
9          raise NotImplementedError()
10
11 class Knight(Character):
12     def attack(self, other):
13         damage = self._defense - other._defense
14         other._health -= damage
```




H6

# Class Tree

# Character Scheme



# Custom Exception

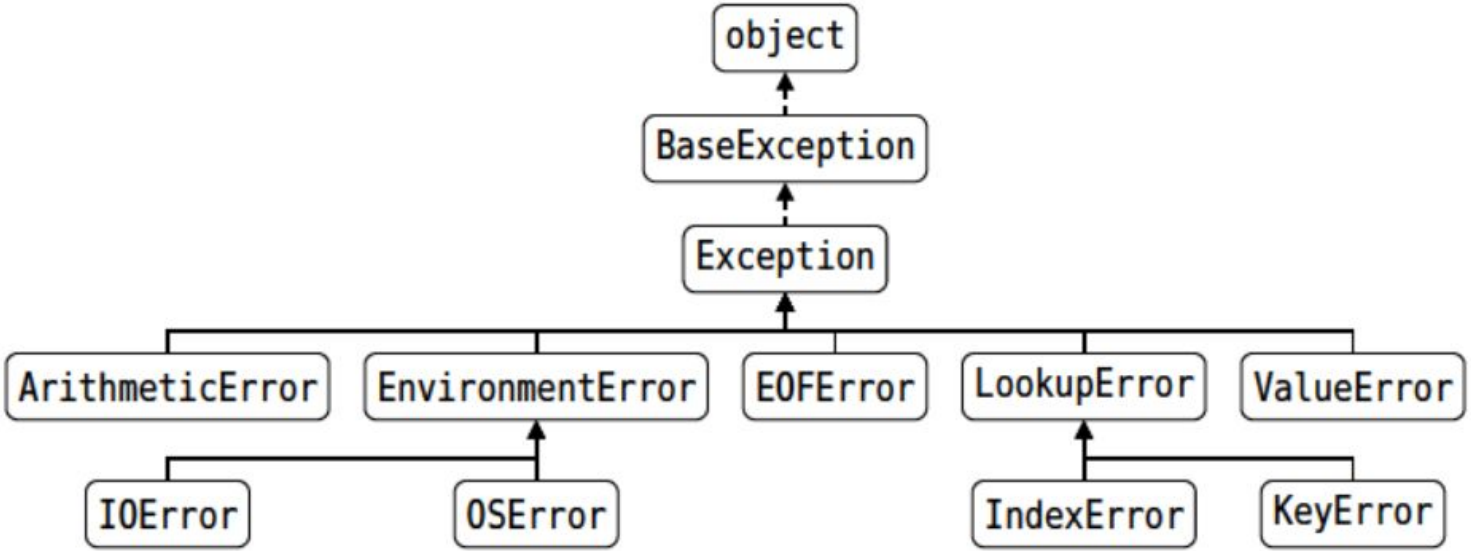
Create your own errors

# Custom Error

custom_error.py

```
1  class CustomError(Exception):
2      pass
3
4  raise CustomError("yikes")
```

# Exception Hierarchy Excerpt



# Custom Error (Specific)

It is best practice to inherit from the closest existing error class

```
1  class InvalidChoiceError(ValueError):
2      pass
3
4  options = ("rock","paper", "scissors")
5  user_choice = input("Pick move (rock/paper/scissors): ")
6
7  if user_choice not in options:
8      raise InvalidChoiceError()
```

# Roughly Equivalent Error

custom_error.py

```
1  class CustomError(Exception):
2      def __init__(self, message):
3          super().__init__(message)
4
5  raise CustomError("yikes")
```

# Custom Error (Complex)

custom_error.py

```
1  class CustomError(Exception):
2      def __init__(self, message, id):
3          message = f"Custom Error [{id}]: {message}"
4          super().__init__(message)
5
6  raise CustomError("yikes", 'a')
```

# Quick Exercise: Number Error

number_error.py

```
1  number = input("Enter positive number [1,100]: ")
2
3  # If input not a number, raise a custom error
4  # If input is not positive, raise a custom error
5  # If input is not between 1 and 100, raise a custom error
```


Magic Methods

# Magic/Dunder Methods

Dunder methods are special, built-in methods that start and end with dunders (double underscores). Using these methods change or add custom behaviors to classes.

| Method Name | Input(s) | Output(s) | Note |
|---|---|---|---|
| __init__ | * | None | Sets behavior when creating objects |
| __str__ | None | String | Used in **`str()`** and **`print()`** |
| __eq__ | Any | Boolean | Sets behavior for **==** operations |
| __add__ | Any | Any | Sets behavior for **+** operations |
| __len__ | None | Integer | Sets behavior when used in **`len()`** |

# Implement: Book

```
1  class Book:
2      def __init__(self, title=None, genre=None, author=None):
3          self.title = title
4          self.genre = genre
5          self.author = author
6
7  book1 = Book("The Hobbit", "Fantasy", "Tolkien")
8  book2 = Book("Dune", "Sci-Fi", "Herbert")
9  print(book1)
```

```
<__main__.Book object at 0x0000019FE4F27BC0>
```

# Magic Method __repr__

The `__repr__` dunder method defines what is used if the object is printed

```
1  class Book:
2      def __init__(self, title=None, genre=None, author=None):
3          self.title = title
4          self.genre = genre
5          self.author = author
6
7      def __repr__(self):
8          return f"{self.title} [{self.genre}] - {self.author}"
9
   book1 = Book("The Hobbit", "Fantasy", "Tolkien")
   book2 = Book("Dune", "Sci-Fi", "Herbert")
   print(book1)
```

```
The Hobbit [Fantasy] - Tolkien
```

# Magic Method __add__

The **__add__** dunder method defines the result when an **+** operation is used with the object

```
1  class Wallet:
2      def __init__(self, initial_amount=0):
3          self.amount = initial_amount
4
5      def __add__(self, other):
6          new_amount = self.amount + other.amount
7          return Wallet(new_amount )
8
9  food_wallet = Wallet(250)
10 transport_wallet = Wallet(1000)
11 total_wallet = food_wallet + transport_wallet
12
13 print("Food Budget: ", food_wallet.amount)
14 print("Transport Budget: ", transport_wallet.amount)
15 print("Total Budget: ", total_wallet.amount)
```

# Object Identity

Python uses the memory location of an object to check for equality

```
1  class Candy:
2      def __init__(self, flavor):
3          self.flavor = flavor
4
5  choco1 = Candy("chocolate")
6  choco2 = Candy("chocolate")
7  milk = Candy("milk")
8
9  print(choco1 == milk)
10 print(choco1 == choco2)
```

# Magic Method __eq__

The **__eq__** dunder method defines whether two objects are equal (or not)

```
1  class Candy:
2      def __init__(self, flavor):
3          self.flavor = flavor
4
5      def __eq__(self, other):
6          return self.flavor == other.flavor
7
8  choco1 = Candy("chocolate")
9  choco2 = Candy("chocolate")
10 milk = Candy("milk")
11
12 print(choco1 == milk)
13 print(choco1 == choco2)
```

05

# GUI

Graphical User Interface

# Benefits of Graphical User Interfaces

## User Experience

Easier to understand and provides appeal and interactivity

## Separation

Clearly Separate Frontend (Design, UI/UX) and Backend (Logic)

## Limitations

Limit the possible edge cases and directly get needed data type

# Python GUI Libraries

## Tkinter

Standard GUI toolkit available in (almost) all Python distributions immediately. Easy to understand and great for building simple applications quickly.

## PyQt

Python bindings or implementations for the Qt application framework. It has a lot of flexible components and great for building complex applications.

## Kivy

Library built specifically for multi-touch platforms (mobile) but can be used in Desktops as well. Good for complex, cross-platform applications.

# Window

01_hello_world.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  root.mainloop()
```

# Window (with Title)

01_hello_world.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4  root.title("Sample GUI Application")
5
6  root.mainloop()
```

# Window (with Size)

01_hello_world.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4  root.title("Sample GUI Application")
5  root.geometry("1200x400")
6
7  root.mainloop()
```

# Label

Adding text to the window

# Label

01_hello_world.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4  root.title("Sample GUI Application")
5  root.geometry("1200x400")
6
7  label = tkinter.Label(root, text="Hello")
8  label.pack()
9
10 root.mainloop()
```

# Multiple Labels

01_hello_world.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4  root.title("Sample GUI Application")
5  root.geometry("1200x400")
6
7  label = tkinter.Label(root, text="Hello")
8  label.pack()
9
10 next_label = tkinter.Label(root, text="World")
11 next_label.pack()
12
13 root.mainloop()
```

# Multiline Label

02_multiline.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  message = """
6  Hello
7  World
8  """
9
10 label = tkinter.Label(root, text=message)
11 label.pack()
12
13 root.mainloop()
```

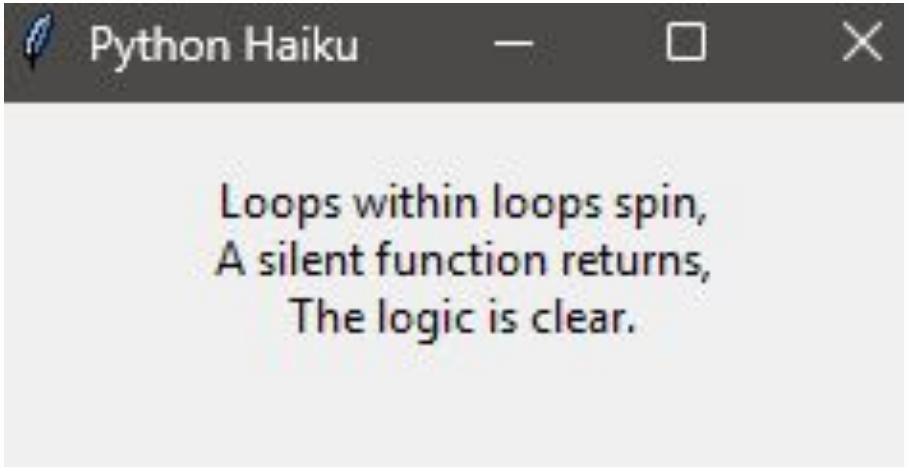
# Message

03_message.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  text = "Sentence 1 Sentence 2 Sentence 3"
6  message = tkinter.Message(root, text=text)
7  message.pack()
8
9  root.mainloop()
```

# Quick Exercise: Haiku

Recreate the following window using label(s)




04_haiku.py

# Properties

Adding styling and layout to components

# Component Font Style

05_font_style.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  label = tkinter.Label(
6      root,
7      text="Hello",
8      font=("Arial", 14, "bold italic")
9  )
10 label.pack()
11
12 root.mainloop()
```

# Find Other Fonts Available

06_font_families.py

```
1  import tkinter
2  from tkinter import font
3
4  root = tkinter.Tk()
5
6  all_fonts = font.families()
7  print(all_fonts)
```

# Component Color

07_colors.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  label = tkinter.Label(
6      root,
7      text="Hello",
8      fg="red",
9      bg="yellow"
10 )
11 label.pack()
12
13 root.mainloop()
```

# Component Size

08_size.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  label = tkinter.Label(
6      root,
7      text="Hello",
8      width=100,
9      height=20
10 )
11 label.pack()
12
13 root.mainloop()
```

# Component Pad

09_pads.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  label = tkinter.Label(
6      root,
7      text="Hello",
8      padx=10,
9      pady=200
10 )
11 label.pack()
12
13 root.mainloop()
```

# Component Pack Side

10_sides.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  label1 = tkinter.Label(root, text="Left")
6  label1.pack(side="left")
7
8  label2 = tkinter.Label(root, text="Right")
9  label2.pack(side="right")
10
11 root.mainloop()
```

# Quick Exercise: Mood Board

Recreate the following window using properties and label(s)


11_mood_board.py

# Entry

Asking the user for text input

# Blank Entry

12_entry_bind.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  entry = tkinter.Entry(root)
6  entry.pack()
7
8  root.mainloop()
```

# Entry Bind

12_entry_bind.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  entry = tkinter.Entry(root)
6  entry.pack()
7
8  def show_input(event):
9      print("Enter pressed")
10
11 root.bind("<Return>", show_input)
12 root.mainloop()
```

# Entry Echo

12_entry_bind.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  entry = tkinter.Entry(root)
6  entry.pack()
7
8  def show_input(event):
9      user_input= entry.get()
10     print(user_input)
11
12 root.bind("<Return>", show_input)
13 root.mainloop()
```

# Entry Echo

12_entry_bind.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  entry = tkinter.Entry(root)
6  entry.pack()
7
8  def show_input(event):
9      user_input= entry.get()
10     print(user_input)
11
12 root.bind("<Return>", show_input)
13 root.bind("<space>", show_input)
14 root.mainloop()
```

# Available Bindings

| Type of Key | Behavior |
| --- | --- |
| Numbers | `<0>, <1>, <2>, <3>, <4>, <5>, <6>, <7>, <8>, <9>` |
| Lowercase Letters | `<a>, <b>, <c>, ...` |
| Uppercase Letters | `<A>, <B>, <C>, ...` |
| Space | `<space>` |
| Special Keys | `<Return>, <Tab>, <Shift>, <Alt_L>, <Escape>, ...` |
| Function Keys | `<F1>, <F2>, <F3>, ...` |
| Navigation Keys | `<Left>, <Right>, <Up>, <Down>` |
| Multiple Keys | `<Control-Shift-s>` |

# Entry Marker

12_entry_bind.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  entry = tkinter.Entry(root)
6  entry.pack()
7
8  def show_input(event):
9      given_text = entry.get()
10     label = tkinter.Label(root, text=given_text)
11     label.pack()
12
13 root.bind("<Return>", show_input)
14 root.bind("<space>", show_input)
15 root.mainloop()
```

# String Variable

Dynamic text for components

# String Variable

13_string_var.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  text = tkinter.StringVar(root, value="Hello")
6  label = tkinter.Label(root, textvariable=text)
7  label.pack()
8
9  root.mainloop()
```

# Dynamic Label

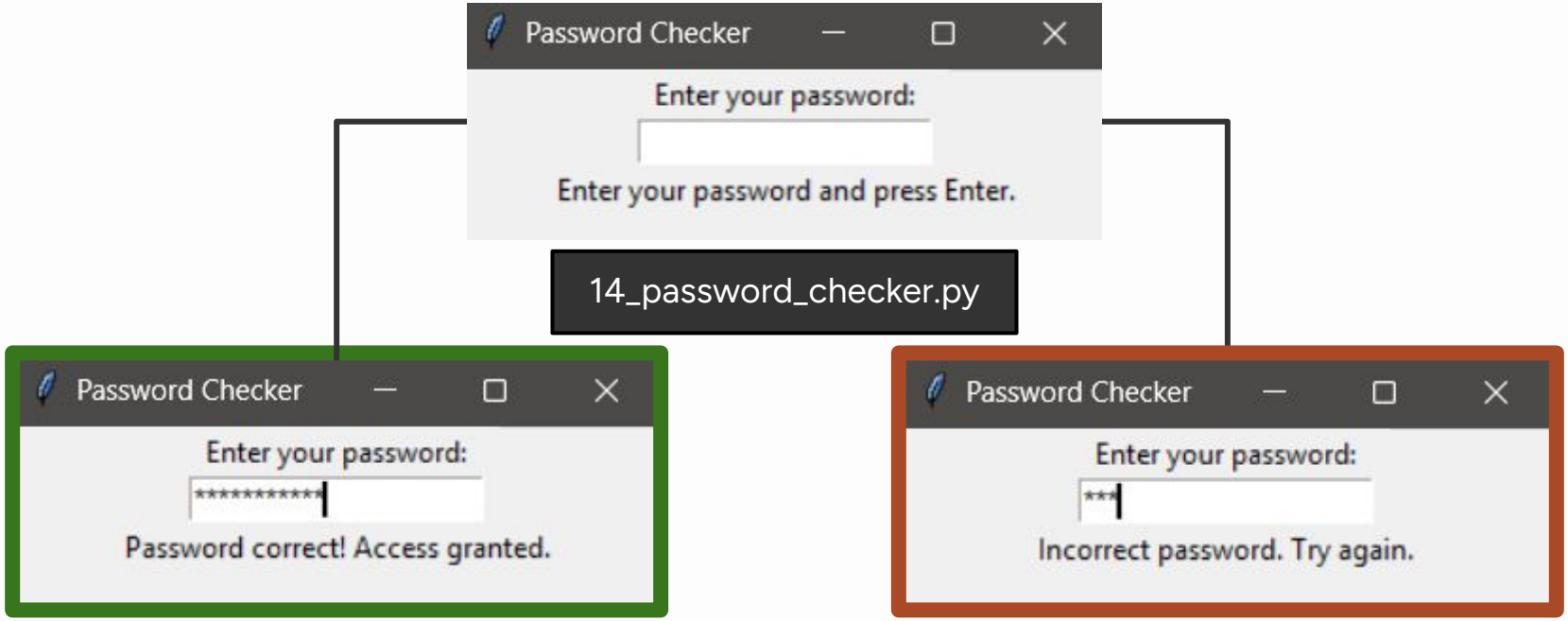
12_entry_bind.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  entry = tkinter.Entry(root)
6  entry.pack()
7
8  user_input = tkinter.StringVar(root, value="Enter any text")
9  label = tkinter.Label(root, textvariable=user_input)
10 label.pack()
11
12 def show_input(event):
13     given_text = entry.get()
14     user_input.set(given_text)
15 ...
```

# Variable Read and Write

```
var.get()
var.set(value)
```

# Quick Exercise: Password Checker



# Buttons

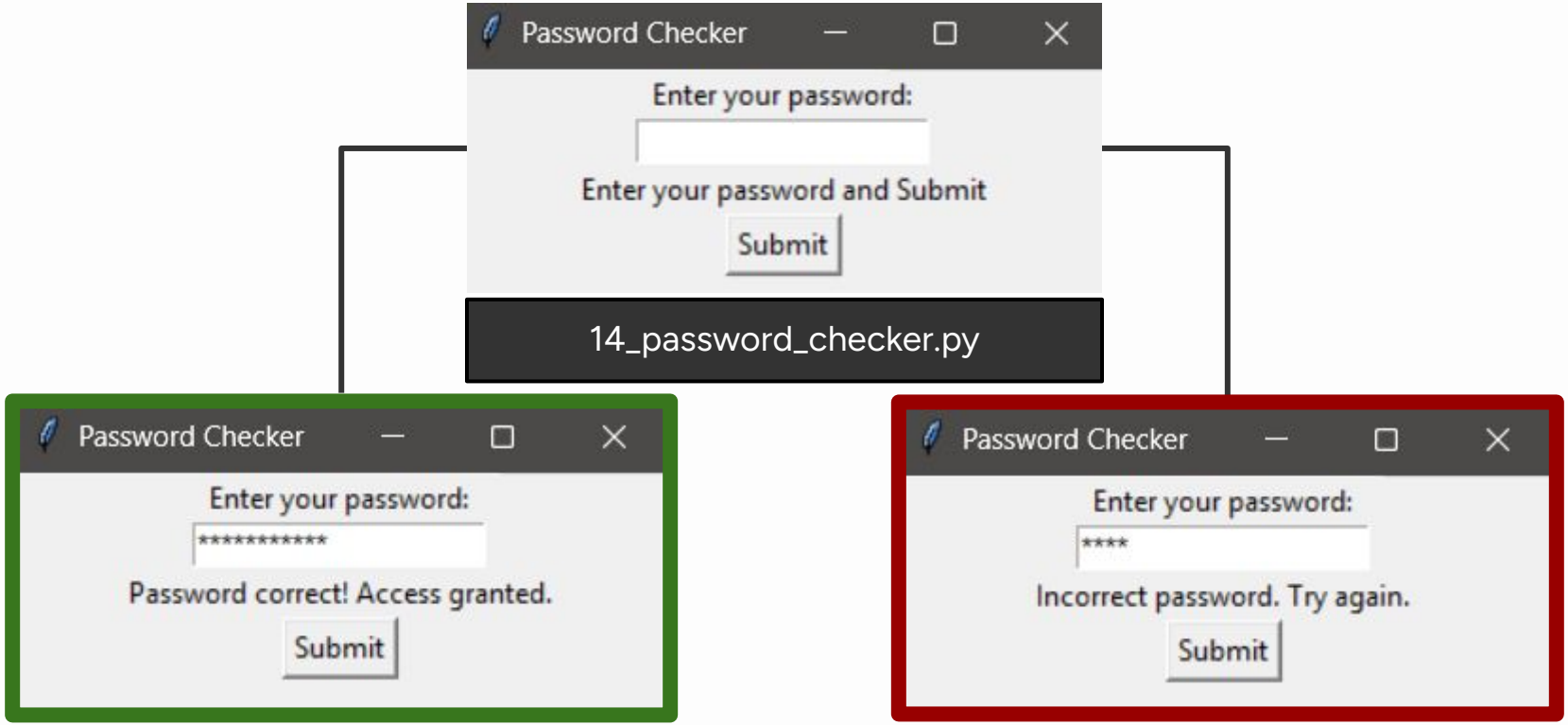
Trigger functions on command

# Dynamic Label (Submit)

15_entry_button.py

```
    ...

12  def show_input():
13      given_text = entry.get()
14      user_input.set(given_text)
15
16  button = tkinter.Button(root, text="Submit", command=show_input)
17  button.pack()
18  root.mainloop()
```

# Quick Exercise: Password Checker



# Int Variable

Dynamic number for components

# Counter

16_counter.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4  count = tkinter.IntVar(root, value=0)
5  label = tkinter.Label(root, textvariable=count)
6  label.pack()
7
8  def increment():
9      new_value = count.get() + 1
10     count.set(new_value)
11
12 button = tkinter.Button(root, text=" + ", command=increment)
13 button.pack()
14
15 root.mainloop()
```

# Quick Exercise: Full Counter

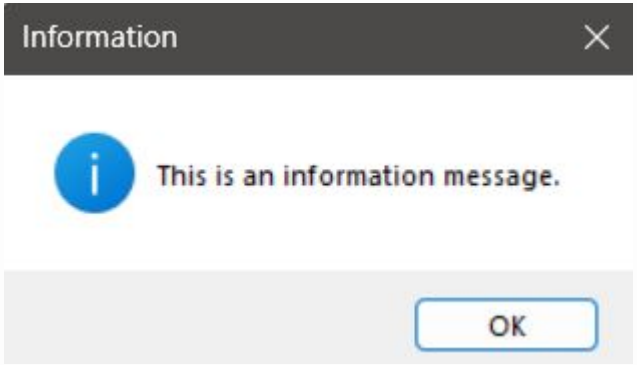

17_full_counter.py

# Message Boxes

Sudden message displays for the user

# Information Box

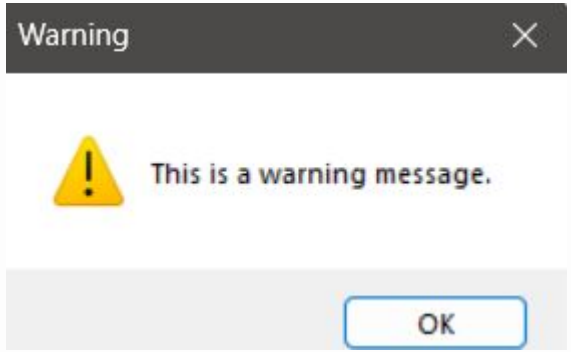
```python
import tkinter
from tkinter import messagebox

root = tkinter.Tk()

messagebox.showinfo(
    "Information",
    "This is an information message."
)

root.mainloop()
```




18_information_box.py

# Warning Box

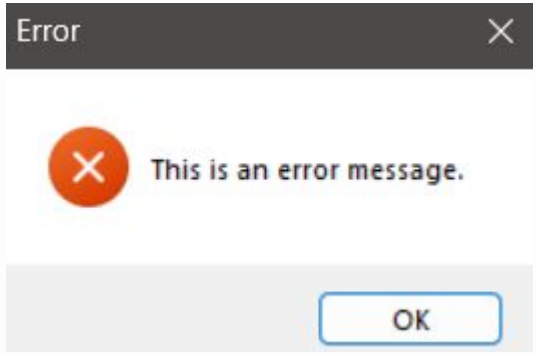
```python
import tkinter
from tkinter import messagebox

root = tkinter.Tk()

messagebox.showwarning(
    "Warning",
    "This is a warning message."
)

root.mainloop()
```




19_warning_box.py

# Error Message Box

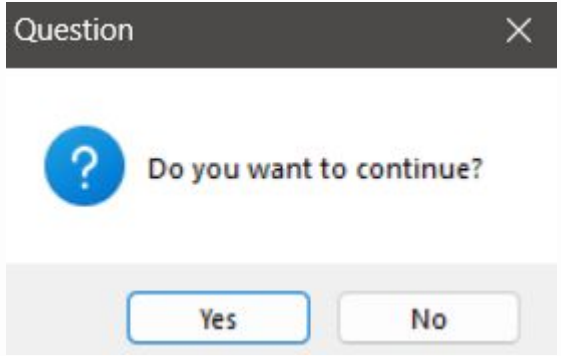
```
1  import tkinter
2  from tkinter import messagebox
3
4  root = tkinter.Tk()
5
6  messagebox.showerror(
7      "Error",
8      "This is an error message."
9  )
10
11 root.mainloop()
12
13
14
15
```




20_error_box.py

# Question Message Box

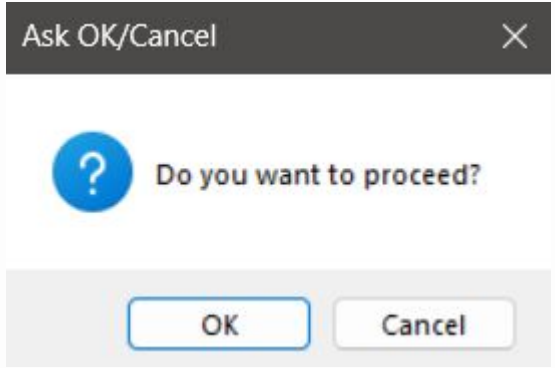
```
1  import tkinter
2  from tkinter import messagebox
3
4  root = tkinter.Tk()
5
6  # yes or no
7  response = messagebox.askquestion(
8      "Question",
9      "Do you want to continue?"
10 )
11
12 root.mainloop()
13
14
15
```




21_question_box.py

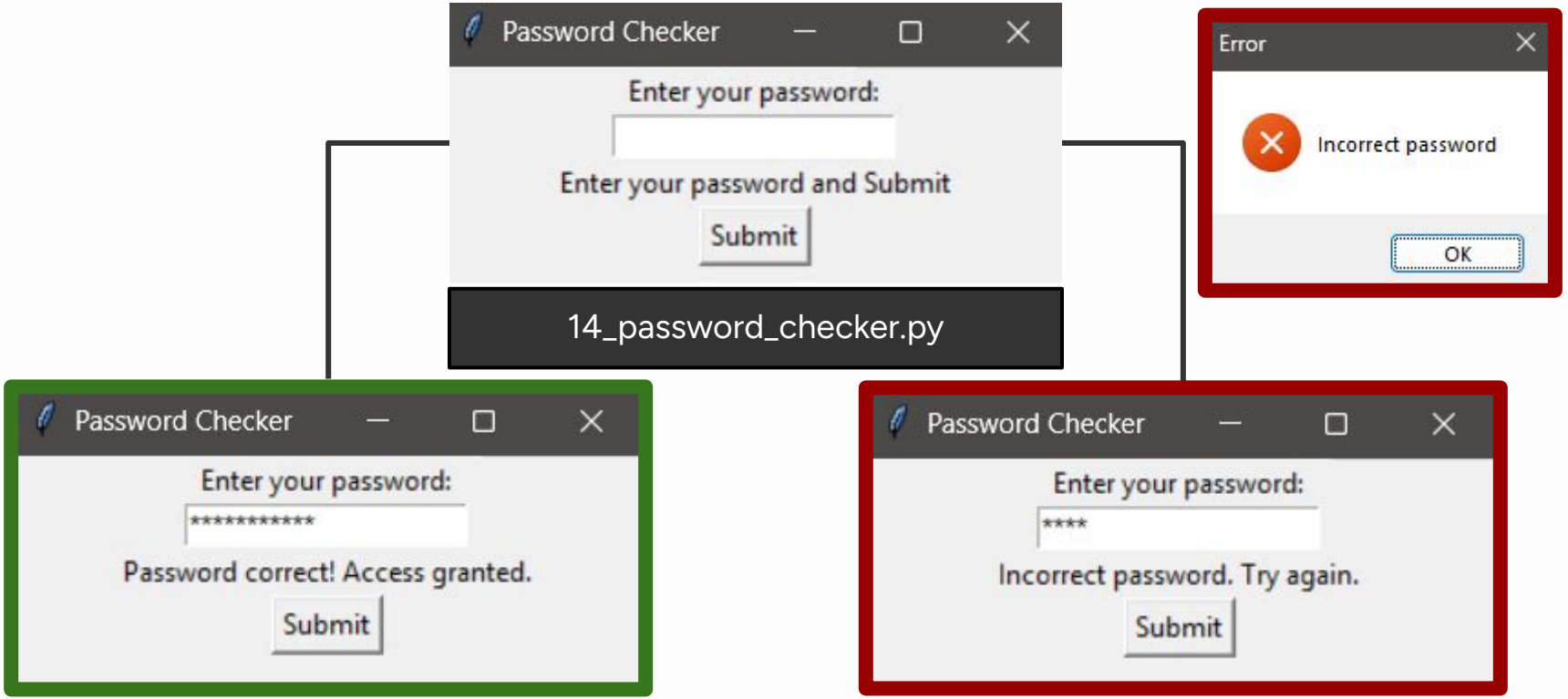
# Ask OK Message Box

```
1  import tkinter
2  from tkinter import messagebox
3
4  root = tkinter.Tk()
5
6  # true or false
7  response = messagebox.askokcancel(
8      "Ask OK/Cancel",
9      "Do you want to proceed?"
10 )
11
12 root.mainloop()
13
14
15
```




22_ok_box.py

# Quick Exercise: Password Checker



# Boolean Variable

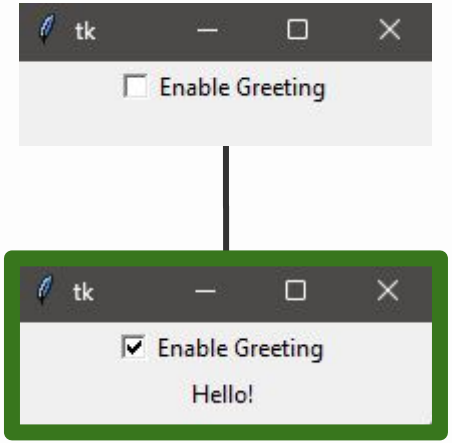
Dynamic boolean for components

# Checkbox

23_checkbox.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  check_value = tkinter.BooleanVar()
6  checkbox = tkinter.Checkbutton(
7      root,
8      text="Enable",
9      variable=check_value
10 )
11 checkbox.pack()
12
13 root.mainloop()
14
15
```

# Quick Exercise: First Greeting




24_first_greeting.py

# Input Components

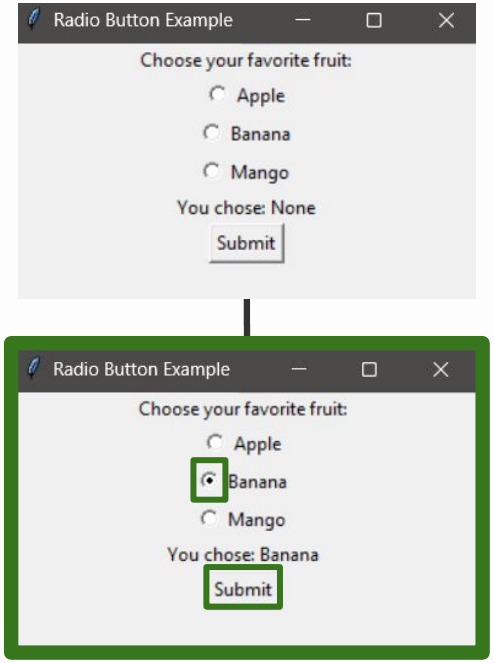
Other basic components for getting user data

# Radio Buttons

25_radio.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  radio_var = tkinter.StringVar(value="Option A")
6  radio1 = tkinter.Radiobutton(
7      root, text="Option A", variable=radio_var, value="Option A")
8  radio1.pack()
9
10 radio2 = tkinter.Radiobutton(
11     root, text="Option B", variable=radio_var, value="Option B")
12 radio2.pack()
13
14 root.mainloop()
```

# Quick Exercise: Store Select



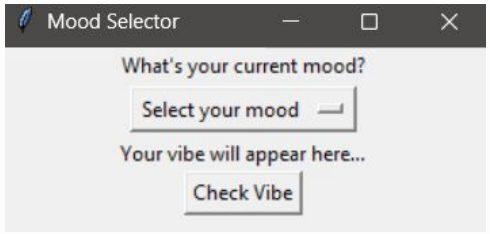

26_store select_.py

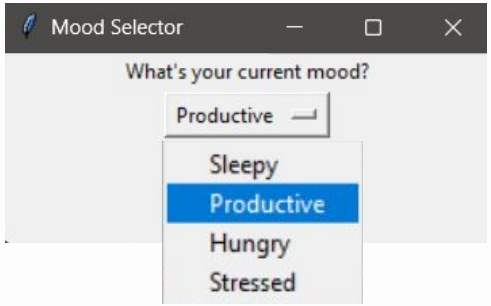
# Dropdown

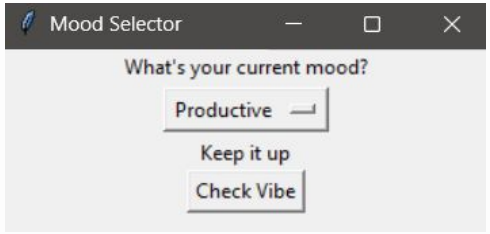
27_dropdown.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  dropdown_var = tkinter.StringVar(value="Choice 1")
6  dropdown_menu = tkinter.OptionMenu(
7      root, dropdown_var,
8      "Choice 1",
9      "Choice 2",
10     "Choice 3"
11 )
12 dropdown_menu.pack()
13
14 root.mainloop()
```

# Quick Exercise: Check Vibe



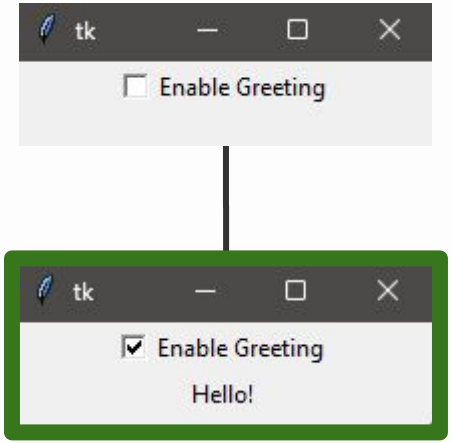

28_check_vibe.py

# Slider

29_slider.py

```python
import tkinter

root = tkinter.Tk()

slider_value = tkinter.IntVar(value=0)
slider = tkinter.Scale(
    root,
    from_=0,
    to=100,
    orient="horizontal",
    variable=slider_value
)
slider.pack()

root.mainloop()
```

# Quick Exercise: Slider




30.py

# SimpleDialog

31_simple_dialog.py

```
1  import tkinter
2  from tkinter import simpledialog
3
4  root = tkinter.Tk()
5
6  def ask_all():
7      name = simpledialog.askstring("String", "Your name?")
8      age = simpledialog.askinteger("Integer", "Your age?")
9      score = simpledialog.askfloat("Float", "Your score?")
10     if name and age and score:
11         message = f"{name} | {age} | {score}"
12         tkinter.Label(root, text=message).pack()
13
14 tkinter.Button(root, text="Start", command=ask_all).pack()
15 root.mainloop()
```

# Layout

Setup the layouting for all of the components by group

# Frames

32_frames.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  left_frame = tkinter.Frame(root, bg="lightblue")
6  left_frame.pack(side="left")
7
8  left_label = tkinter.Label(left_frame, text="I'm on the left")
9  left_label.pack()
10
11 right_frame = tkinter.Frame(root, bg="lightgreen")
12 right_frame.pack(side="right")
13
14 right_entry = tkinter.Entry(right_frame)
15 right_entry.pack()
16 right_button = tkinter.Button(right_frame, text="Click me")
17 right_button.pack()
18
19 root.mainloop()
```

# Grids

33_grids.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4
5  top = tkinter.Label(root, text="Top", bg="blue", width=40, height=2)
6  top.grid(row=0, column=0, columnspan=3, sticky="nsew")
7  side = tkinter.Label(root, text="Side", bg="green", width=15, height=4)
8  side.grid(row=1, column=0, rowspan=2, sticky="nsew")
9  cell_1_1 = tkinter.Label(root, text="1,1", bg="gray", width=15, height=2)
10 cell_1_1.grid(row=1, column=1)
11 cell_1_2 = tkinter.Label(root, text="1,2", bg="gray", width=15, height=2)
12 cell_1_2.grid(row=1, column=2)
13 cell_2_1 = tkinter.Label(root, text="2,1", bg="yellow", width=15, height=2)
14 cell_2_1.grid(row=2, column=1)
15 cell_2_2 = tkinter.Label(root, text="2,2", bg="yellow", width=15, height=2)
16 cell_2_2.grid(row=2, column=2)
17
18 root.mainloop()
```

# Frame and Grids

34_frames_grid.py

```
1  import tkinter
2
3  root = tkinter.Tk()
4  root.title("Login Form")
5
6  form_frame = tkinter.Frame(root, padx=20, pady=20)
7  form_frame.pack()
8
9  tkinter.Label(form_frame, text="Username:").grid(row=0, column=0)
10 username_entry = tkinter.Entry(form_frame)
11 username_entry.grid(row=0, column=1)
12
13 tkinter.Label(form_frame, text="Password:").grid(row=1, column=0)
14 password_entry = tkinter.Entry(form_frame, show="*")
15 password_entry.grid(row=1, column=1)
16
17 login_button = tkinter.Button(form_frame, text="Login")
18 login_button.grid(row=2, column=0, columnspan=2, pady=10)
19 root.mainloop()
```

# Class Organization

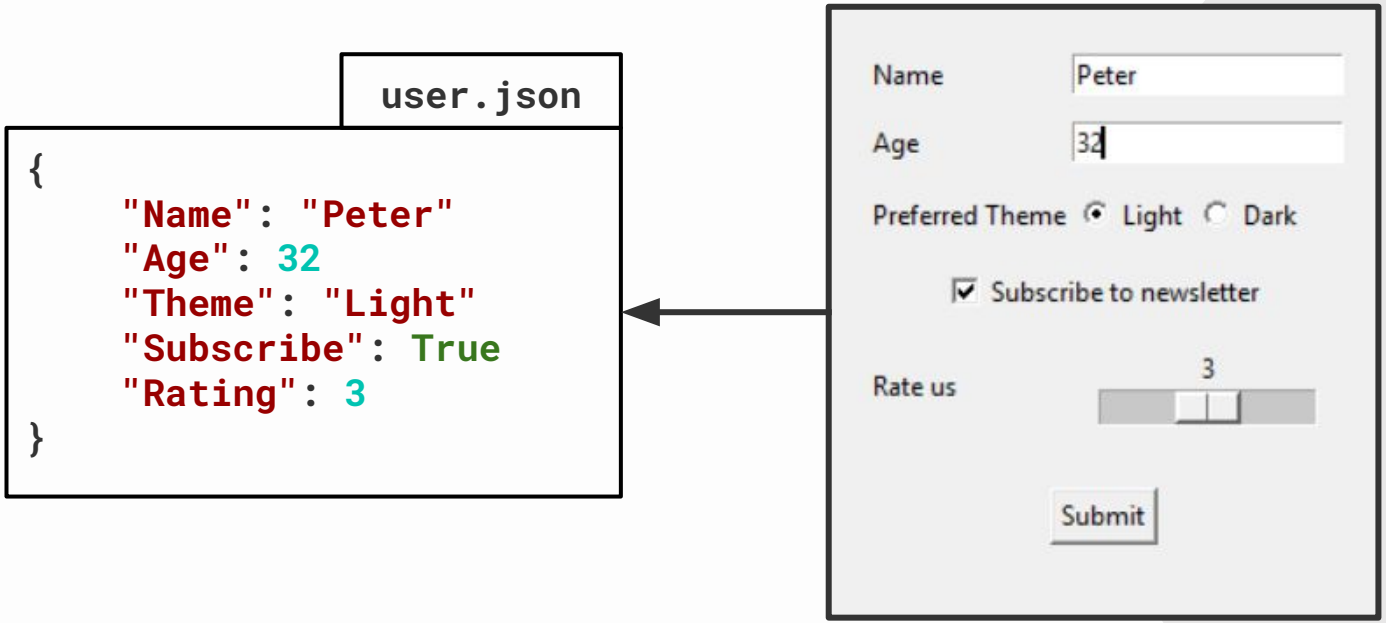
35_tkinter_class.py

```
1  import tkinter
2
3  class Application(tkinter.Tk):
4       def __init__(self):
5            super().__init__()
6            self.title("Tkinter Class Structure")
7            self.geometry("300x200")
8            self.create_widgets()
9
10      def create_widgets(self):
11           label = tkinter.Button(self, text="Hello", command=self.hello)
12           label.pack()
13
14      def hello(self):
15           print("Hello")

app = Application()
app.mainloop()
```

H7

# User Settings

Common starting project for GUI


user.json
{
"Name": "Peter"
"Age": 32
"Theme": "Light"
"Subscribe": True
"Rating": 3
}
Name
Peter
Age
32
Preferred Theme
Light
Dark
Subscribe to newsletter
Rate us
3
Submit

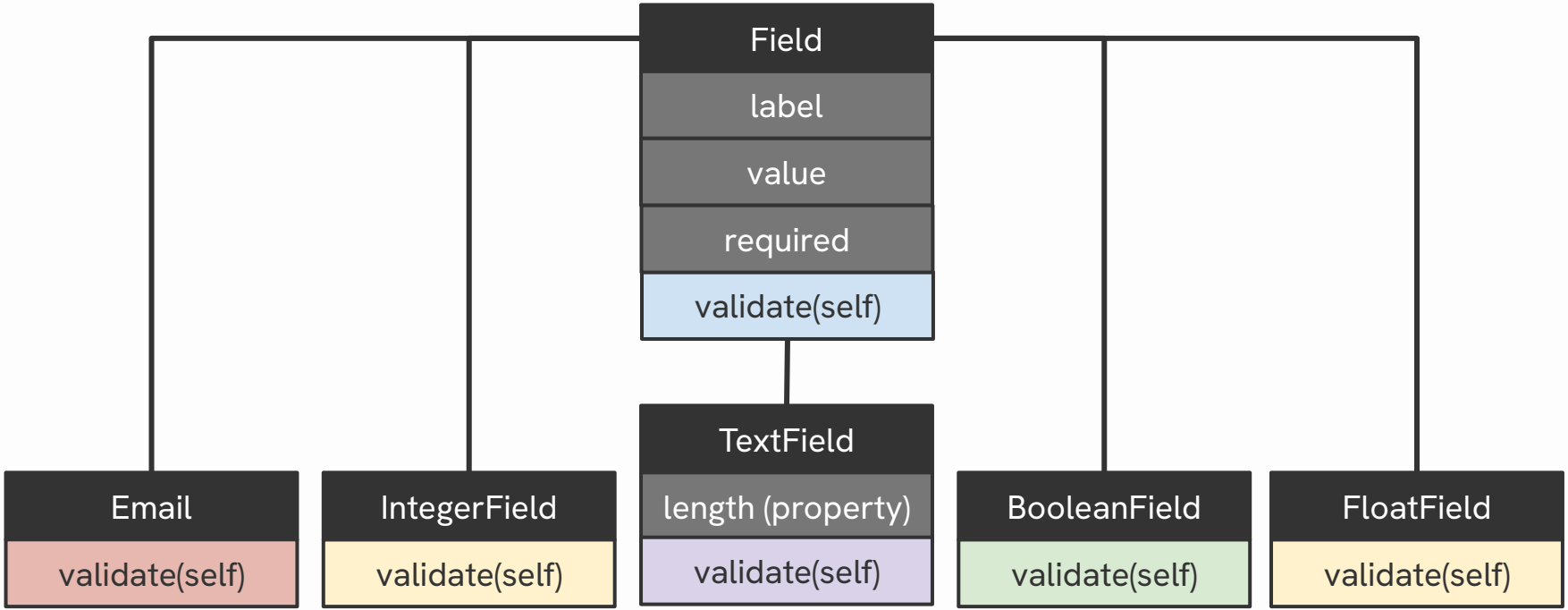
06

# Lab Session

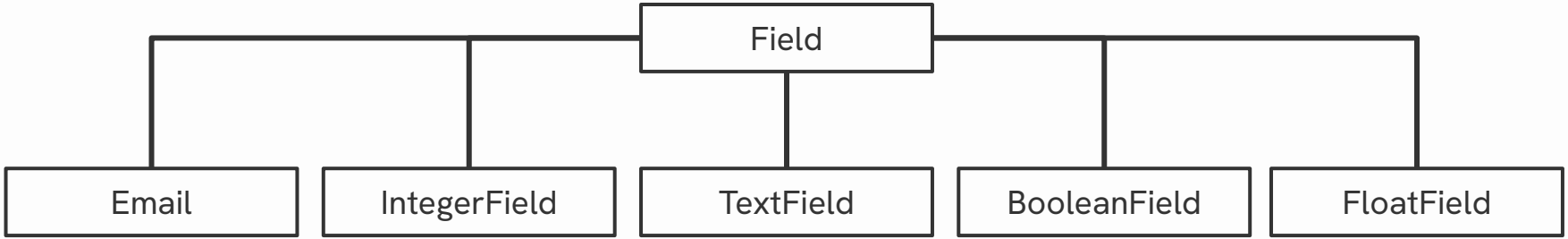
All the Major Features Covered


Fields

# Initial Fields

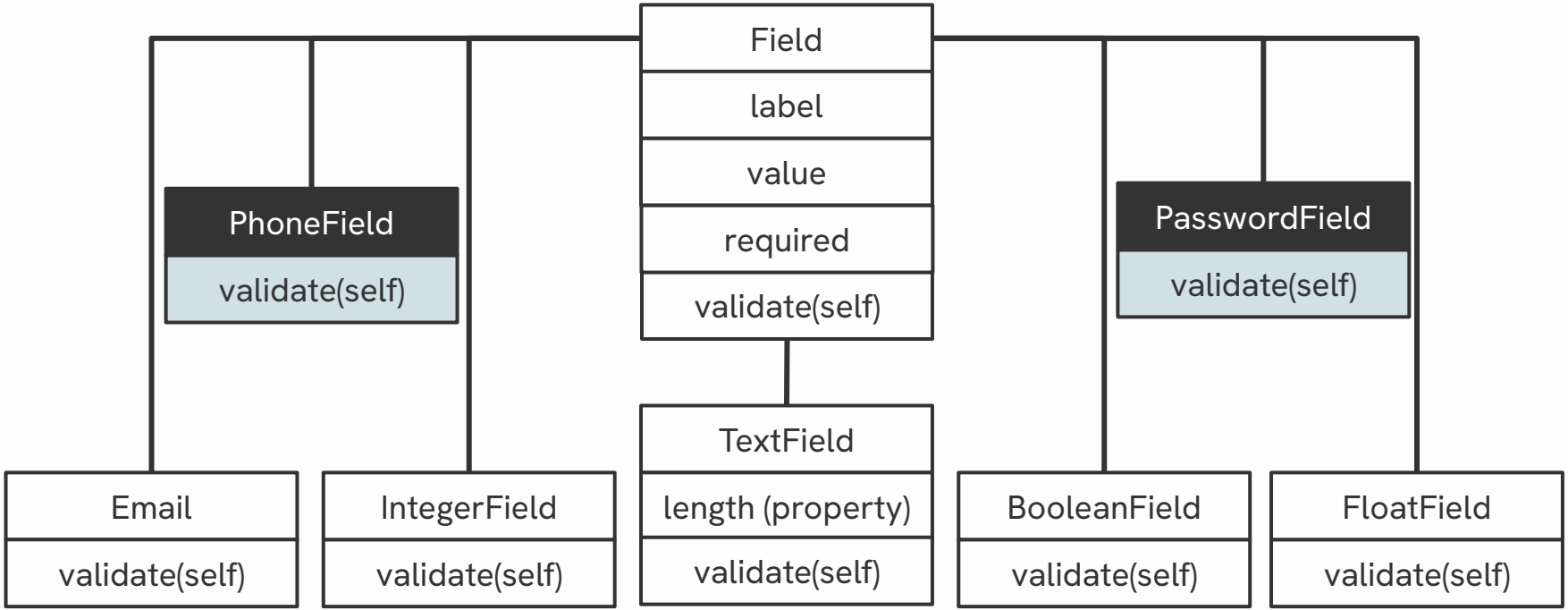


# Forms with Fields




| Form |
| --- |
| fields |
| add(self, field) |
| remove(self, field) |
| validate(self) |
| save(self, filepath) |

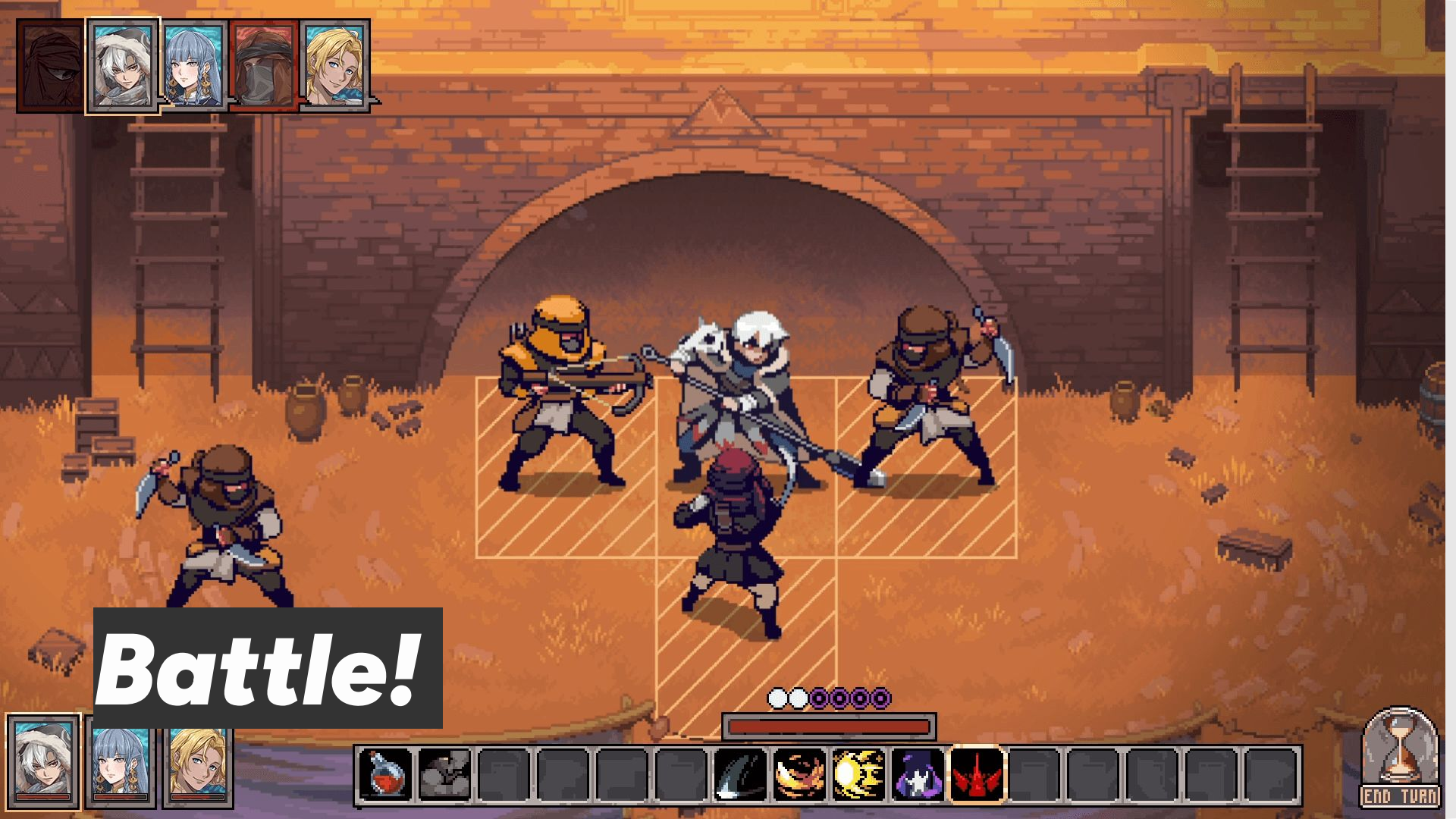
# Field Intermediate



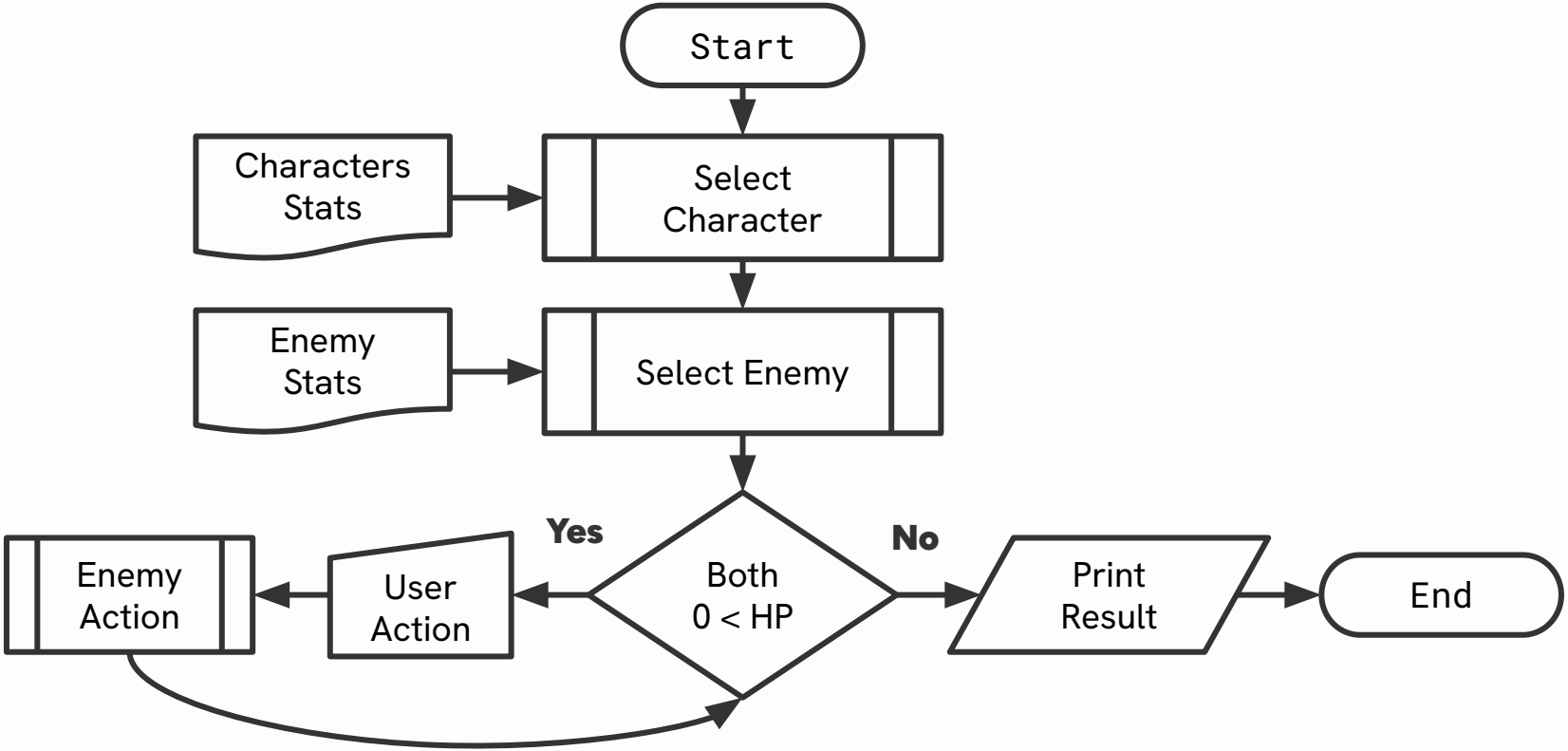

Inbox

| Inbox |
| --- |
| emails |
| add(self, email) |
| show(self, index) |
| delete(self,index) |
| search(self, keywords) -> Email |
| __add__(self) |
| __repr__(self) |
| WorkInbox |
| archived (property) |
| read (property) |
| unread(property) |

| Email |
| --- |
| sender |
| subject |
| message |
| date |
| read_status |
| archive_status |
| __repr__(self) |
| read(self) |
| unread(self) |
| archive(self) |
| unarchive(self) |


Battle!
END TURN

# Battle! Game Flow



# Sneak Peak

01

## Packaging

Handling Python Files

02

## Concurrency

Multitasking techniques

03

## Best Practices

Writing Pythonic code

04

## Testing

Code correctness

05

## Web Dev

Introduction to Flask

06

## Lab Session

Culminating Exercise

# Python: Day 03

Object-Oriented Programming