First Steps in Object-Oriented Programming

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Project Architecture

Splitting Code into Logical Parts

Splitting Code into Functions (1)

- We use **methods** to split code into functional blocks
  - Improves code **readability**
  - Allows for easier **debugging**

```
for move in moves:
  for row in range(len(room)):
    for col in range(len(room[row])):
      if room[row][col] == 'b':
        …
```

```
for move in moves:
    def move_enemies()
    def killer_check()
    def move_player(move)
```

Splitting Code into Functions (2)

- A **single** function should complete a **single task**

```
do_magic ( … )
deposit_or_withdraw ( … )
deposit_and_get_balance ( … )
parse_data_and_return_result ( … )
```

$\Downarrow$

```
withdraw ( … )
deposit ( … )
get_balance ( … )
to_string ( … )
```

Problem: Rhombus of Stars

- Draw on the console a rhombus of stars with a size of **n**

```
n = 3
```

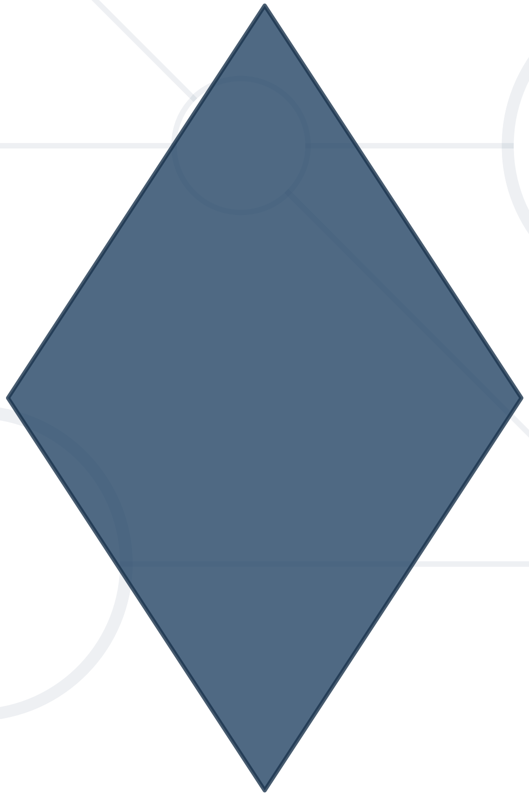
```
  *
 * *
* * *
 * *
  *
```

```
n = 2
```

```
 *
* *
 *
```

```
n = 1
```

```
*
```



Solution: Rhombus of Stars

```
def print_row(size, star_count):
    for row in range(size - star_count):
        print(" ", end="")
    for row in range(1, star_count):
         print("*", end=" ")
    print("*")
```

Reusing code

```
size = int(input())
for star_count in range(1, size):
  print_row(size, star_count)
for star_count in range(size, 0, -1):
  print_row(size, star_count)
```

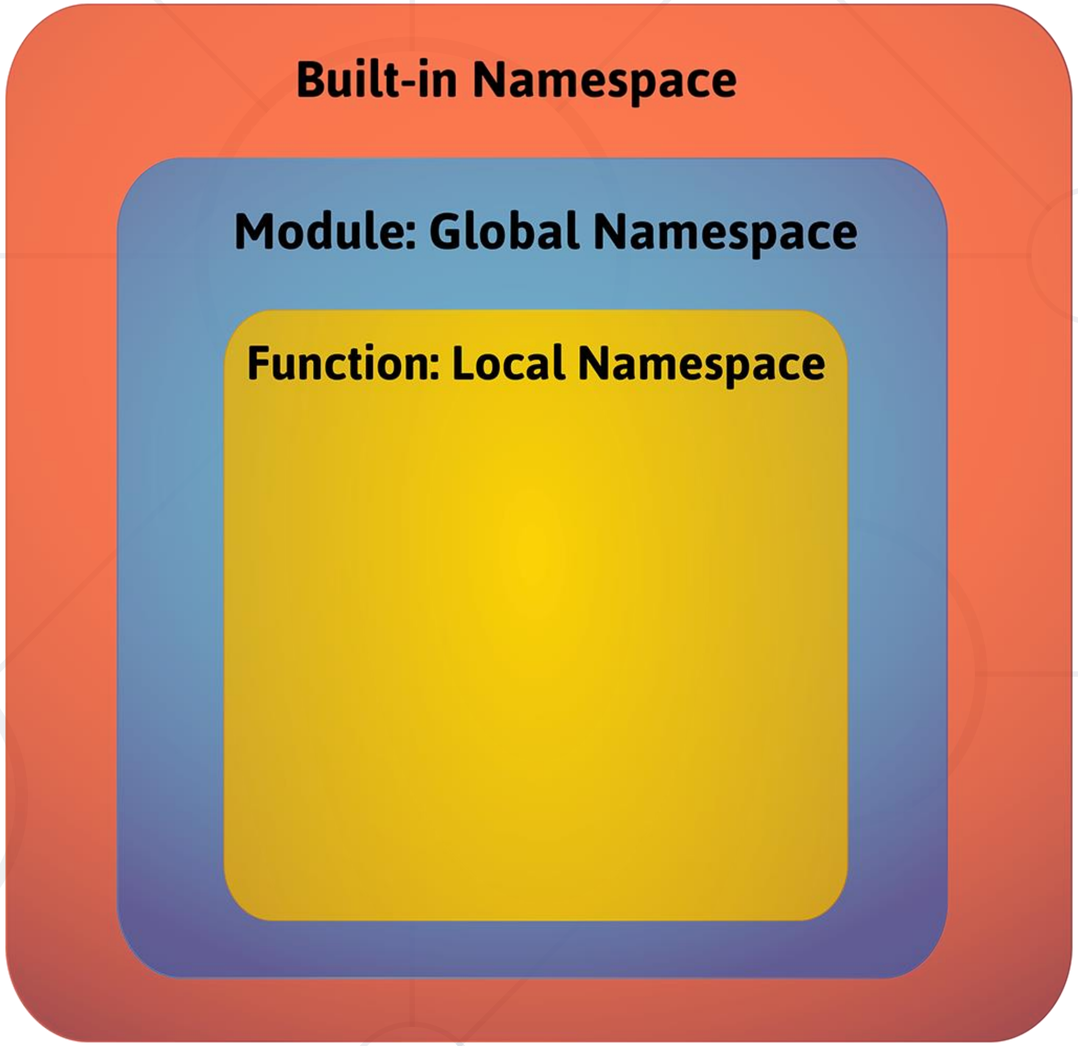
Scope and Namespace

Local, Global and Built-In Namespace

What is Namespace?

- A mapping from names to objects
- Examples:
  - **Built-in** names, for example the **`abs()`** function
  - **Global** names in a module
  - **Local** names on a function invocation
- There is no relation between names in different **namespaces**

Namespaces Order



What is a Scope?

- A region in a program where a **namespace** is directly accessible
- In most of the cases there are at least three nested **scopes**:
  - The **innermost** is checked first
  - The scopes of any **enclosing functions**
  - The next-to-last scope (module's **global** names)
  - The outermost (**built-in** names)

Scopes Example

```
def scopes():
    def local_scope():
        text = "local text"
```

Local Scope

```
def nonlocal_scope():
        nonlocal text
        text = "nonlocal text"
```

Nonlocal Scope

```
def global_scope():
        global text
        text = "global text"
```

Global Scope

Problem: Scope Mess

- Fix the provided code, so it prints the result expected
- Download the code from here

```
# current output
global
outer: local
inner: nonlocal
outer: local
global
```

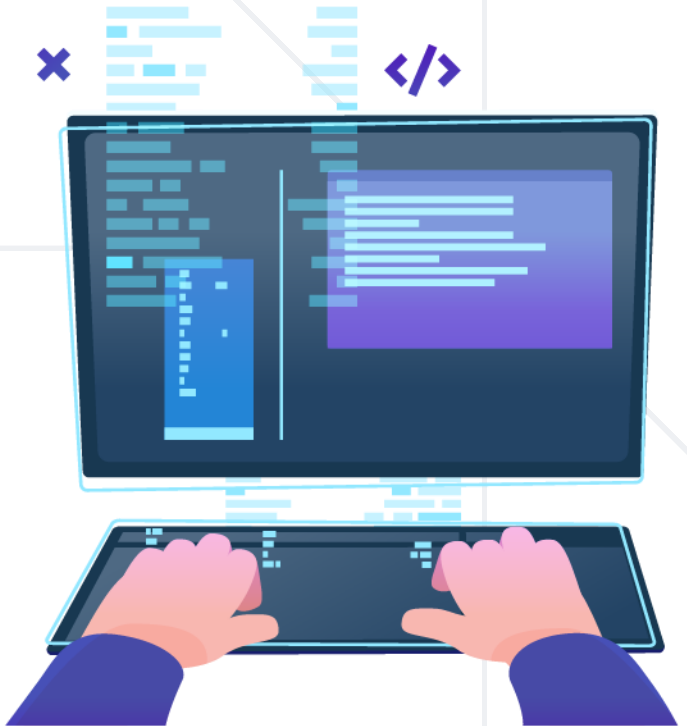
```
# expected output
global
outer: local
inner: nonlocal
outer: nonlocal
global: changed!
```

Solution: Scope Mess

- Here are the changes that need to be made

```
def inner():
    nonlocal x
    x = "nonlocal"
    print("inner:", x)
```

```
def change_global():
    global x
    x = "global: changed!"
```

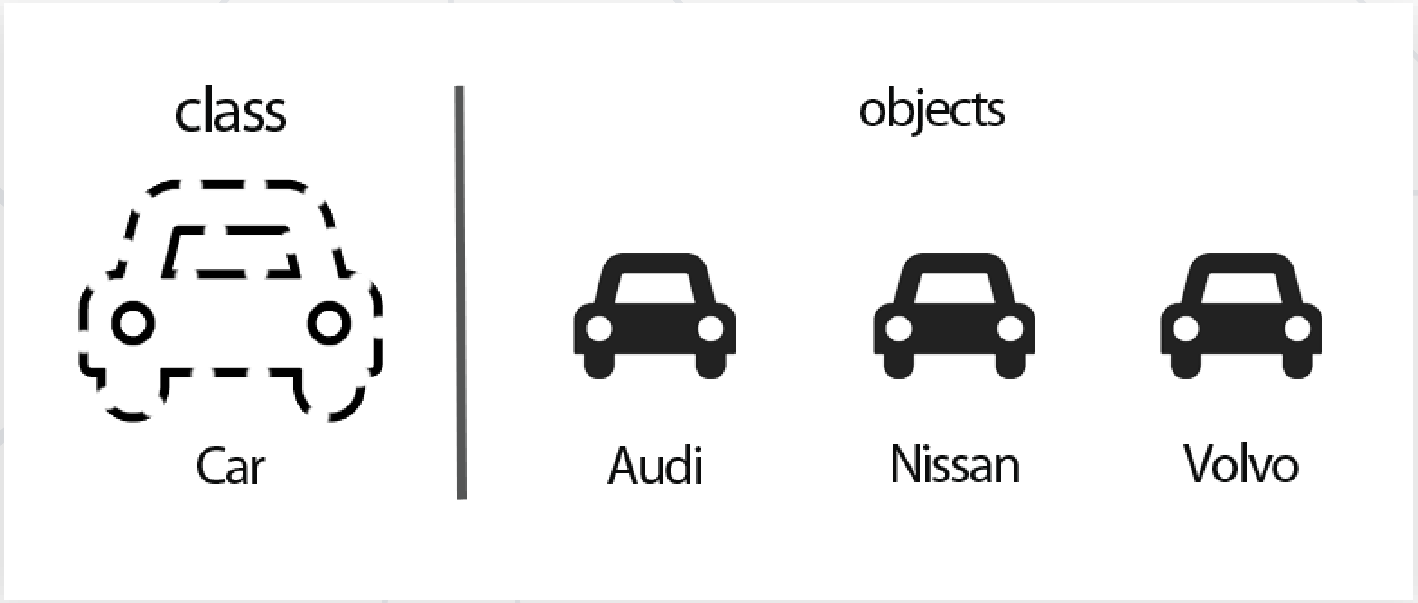


Basics of OOP

Building Data Functionality Together

What is an Object-Oriented Programming?

- It is the **most popular** programming paradigm
- It relies on the concept of **classes and objects**
- A **class** is used to create an **individual instance** of an **object**



Advantages of OOP

- Provides a **clear program structure** and a **clean code**
- **Reduces** complexity
- Make it **easy to write** a reusable code
- Could **test** each behavior of an object **separately**
- Facilitates **easy maintenance** and **modification** of existing code

Objects in Python

- **Everything** in Python is **an object** and has **a type**
  - 10.5
  - "Python"
  - [1, 2, 3, 4]
  - {"name": "Peter", "age": 26}
- We could **create** as many objects as we like, **manipulate** them, or **remove** them

Example

- **Create** an object of type list

```
numbers = [1, 2, 3, 4, 8, 10]
```

Internal representation of the list is private

- **Manipulate** the object by adding an element

```
numbers.append(5)
print(numbers) # [1, 2, 3, 4, 8, 10, 5]
```

You just need to know how to use its methods

- **Remove** the object

```
del numbers
print(numbers) # Error
```

What is an Object?

- Object is a **data abstraction** that captures an **internal representation** and **an interface**
- The internal representation should be **private**
- The interface **defines behaviors** but **hides implementation**

Characteristics of an Object

- State
  - Help to distinguish an object from other objects
  - A phone could have a color, a size, a weight
- Behavior
  - The tasks that an object performs
  - A phone could turn on, turn off

What is a Class?

- The class is a **blueprint that defines the nature** of a future object
- In Python, a class is created by the keyword `class`

Class Name

```
class Phone:
    def __init__(self, color, size):
        self.color = color
        self.size = size

    def turn_on(self):
        return 'The phone is turned on'
```

State

Behavior

What is an Instance?

- **Specific realization** of an object of a certain class
- The creation of an instance is called **instantiation**

```
class Phone:
    def __init__(self, color, size):
        self.color = color
        self.size = size

phone = Phone("blue", 4.7)
```

Instance

Creating and Using Classes

Creating a Class

- The keyword **class** defines a **new type**

```
class Person:
    pass
```

Type Person

- We define **the state** of the object using **attributes**

Special Method

```
class Person:
    def __init__(self, name, age):
        self.name = name
        self.age = age
```

Attributes

Problem: Class Book

- Create a class called **Book**
- Upon initialization, it should receive a **name**, **author**, and **pages** (number)
- Submit only the class in the judge system
- Use test code to test your code

```
book = Book("My Book", "Me", 200)
print(book.name)
print(book.author)
print(book.pages)
```

```
My Book
Me
200
```

Solution: Class Book

```
class Book:
    def __init__(self, name, author, pages):
        self.name = name
        self.author = author
        self.pages = pages
```

Method

- We define **the behavior** of the object using **methods**
- It is like a function, that **works only within a class**

Defining a Method

```
class Animal:
    def __init__(self, name):
        self.name = name

    def sleep(self):
        return "sleeping.."

animal = Animal("cat")
print(animal.sleep()) # sleeping..
```

Using a Class

- Using a class means **creating new instances** of object and **executing operation** on the instances

```python
class Person():
    def __init__(self, name, age):
        self.name = name
        self.age = age

    def eat(self):
        return 'eating..'

person = Person()
print(person.eat()) # eating..
```

Instance

Problem: Car

- Create a class **Car** that receives **name**, **model**, and **engine** upon initialization
- It should have **a method** called **get_info()** which returns **'This is {name} {model} with engine {engine}'**
- Submit only the class in the judge system

```
car = Car("Kia", "Rio", "1.3L B3 I4")
print(car.get_info())
```

```
This is Kia Rio with engine 1.3L B3 I4
```

Solution: Car

```python
class Car:
    def __init__(self, name, model, engine):
        self.name = name
        self.model = model
        self.engine = engine

    def get_info(self):
        return f'This is {self.name} {self.model} ' \
               f'with engine {self.engine}'
```

Problem: Music

- Create a class `Music` that receives `title`, `artist`, and `lyrics` upon initialization
- It should have **2 methods**
  - `print_info()` - returns `'This is {title} from {artist}'`
  - `play()` - returns the lyrics
- Submit only the class in the judge system
- Test your code with your own examples

Solution: Music

```python
class Music:
    def __init__(self, title, artist, lyrics):
        self.title = title
        self.artist = artist
        self.lyrics = lyrics

    def print_info(self):
        return f'This is "{self.title}" from "{self.artist}"'

    def play(self):
        return self.lyrics
```

Summary

- **OOP** relies on the concept of classes and objects
- **Object** is a data abstraction that captures an internal representation and an interface
- **Class** is a blueprint that defines a nature of a future object
- **Instance** is a specific realization of any object

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