Introduction to Inheritance and Object Oriented Programming

Example Instruction Demo

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Outline

What Problems Do Objects Solve

- Programs consistent of data. . .
  - Simple: numbers and letters
  - Complex: measurements associated with timestamps

What Problems Do Objects Solve

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- and functions
    - Simple: addition and concatenation
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What Problems Do Objects Solve

- Programs consistent of data. . .
  - Simple: numbers and letters
  - Complex: measurements associated with timestamps
- and functions
  - Simple: addition and concatenation
  - Complex: sampling measurements to have timestamps in 30 minute intervals
- Objects combine functions with data
  - Simple:

```
1 >>> "cat" + "dog"
2 'catdog'
```

  - Complex:

```
1 >>> measurements.resample("30min").bfill()
2 0    73.0
3 30   75.0
4 60   74.0
5 dtype: float64
```

What Problems Does Inheritance Solve

Inheritance

The process of creating classes of objects from existing classes

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  - Reused portions can be modified

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Inheritance

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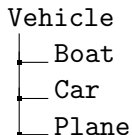 - Reused portions can be modified
- Describes what to expect from every type of an object
  - Every number should allow math operations
  - Every "Vehicle" in a video game should allow "driving"

Example of a Vehicle being the parent to various drivable objects

```
Vehicle
  Boat
  Car
  Plane
```

The Shape Class

code/shapes/shape.py

```python
1 from abc import ABC, abstractmethod
2
3 class Shape(ABC):
4     @abstractmethod
5     def area(self):
6         pass
```

Classes Vs Objects

This is a class, it defines what an object is. This is distinct from being an instance of an object

The Rectangle Class

code/shapes/rectangle.py

```python
1  from shapes.shape import Shape
2
3  class Rectangle(Shape):
4      def __init__(self, length: float, width: float):
5          self.length = length
6          self.width = width
7
8      def area(self):
9          return self.length * self.width
```

Our First Rectangle

code/main.py

```
1 rect = Rectangle(4, 5)
2 print(f"rect area: {rect.area()}")
```

output

```
1 rect area: 20
```

Instances of Objects

circ is an object as it is an instance of Circle

Code Snippets

main.py and the output will be shown in snippets. The full text is in the appendix.

Two Rectangles

code/main.py

```
1 rect = Rectangle(4, 5)
2 print(f"rect area: {rect.area()}")
3
4 rect2 = Rectangle(3,8)
5 print(f"rect2 area: {rect2.area():.2f}")
6
7 print(f"rect.area() > rect2.area(): {rect.area() >
    rect2.area()}")
```

output

```
1 rect area: 20
2 rect2 area: 24.00
3 rect.area() > rect2.area(): False
```

The Circle Class

code/shapes/circle.py

```python
1  from shapes.shape import Shape
2  import math
3
4  class Circle(Shape):
5      def __init__(self, radius: float):
6          self.radius = radius
7
8      def area(self):
9          return math.pi * math.pow(self.radius, 2)
```

Comparing Our Shapes

code/main.py

```python
rect = Rectangle(4, 5)
print(f"rect area: {rect.area()}")
circ = Circle(3)
print(f"circ area: {circ.area():.2f}")

print(f"circ.area() > rect.area(): {circ.area() > rect
    .area()}")
```

output

```
rect area: 20
```

```
circ area: 28.27
circ.area() > rect.area(): True
```

The Extended Shape Class

code/shapes/shape.py

```python
1  from abc import ABC, abstractmethod
2
3  class Shape(ABC):
4      @abstractmethod
5      def area(self):
6          pass
7
8      def __gt__(self, other) -> bool:
9          if isinstance(other, Shape):
10             return self.area() > other.area()
11         else:
12             raise ValueError("Can only compare with
       shapes")
```

Comparing Our Shapes, With Style

code/main.py

```python
rect = Rectangle(4, 5)
print(f"rect area: {rect.area()}")

rect2 = Rectangle(3,8)
print(f"rect2 area: {rect2.area():.2f}")

circ = Circle(3)
print(f"circ area: {circ.area():.2f}")

print(f"rect > rect2: {rect > rect2}")
print(f"circ > rect: {circ > rect}")
```

output

```
rect area: 20
rect2 area: 24.00

circ area: 28.27

rect > rect2: False
circ > rect: True
```

Folder Structure

```
code/
 ┣━ main.py
 ┗━ shapes/
     ┣━ shape.py
     ┣━ rectangle.py
     ┗━ circle.py
```

main.py

```python
1 #!/bin/env python3
2 from shapes.rectangle import Rectangle
3 from shapes.circle import Circle
4
5
6 rect = Rectangle(4, 5)
7 print(f"rect area: {rect.area()}")
8
9 rect2 = Rectangle(3,8)
10 print(f"rect2 area: {rect2.area():.2f}")
11
12 print(f"rect.area() > rect2.area(): {rect.area() >
      rect2.area()}")
13
14 circ = Circle(3)
15 print(f"circ area: {circ.area():.2f}")
```

main.py – cont

```
1
2 print(f"circ.area() > rect.area(): {circ.area() > rect
     .area()}")
3
4
5 print(f"rect > rect2: {rect > rect2}")
6 print(f"circ > rect: {circ > rect}")
```

shapes/shape.py

```python
1 from abc import ABC, abstractmethod
2
3 class Shape(ABC):
4     @abstractmethod
5     def area(self):
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7
8     def __gt__(self, other) -> bool:
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shapes/rectangle.py

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1  from shapes.shape import Shape
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4      def __init__(self, length: float, width: float):
5          self.length = length
6          self.width = width
7
8      def area(self):
9          return self.length * self.width
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shapes/circle.py

```python
1  from shapes.shape import Shape
2  import math
3
4  class Circle(Shape):
5      def __init__(self, radius: float):
6          self.radius = radius
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8      def area(self):
9          return math.pi * math.pow(self.radius, 2)
```

```
1 rect area: 20
2 rect2 area: 24.00
3 rect.area() > rect2.area(): False
4 circ area: 28.27
5 circ.area() > rect.area(): True
6 rect > rect2: False
7 circ > rect: True
```