Inheritance and Polymorphism

Extended Class (Subclass): *Shifted_Circle*()

```
class Shifted_Circle(Circle):
    def __init__(self, x = 0, y = 0, r = 1):
        Circle.__init__(self, r)
        self.__x = x
        self.__y = y
        self.__radius = r

    def distance(self):
        return (self.__x**2 + self.__y**2)**0.5
```

Python Subclass Template

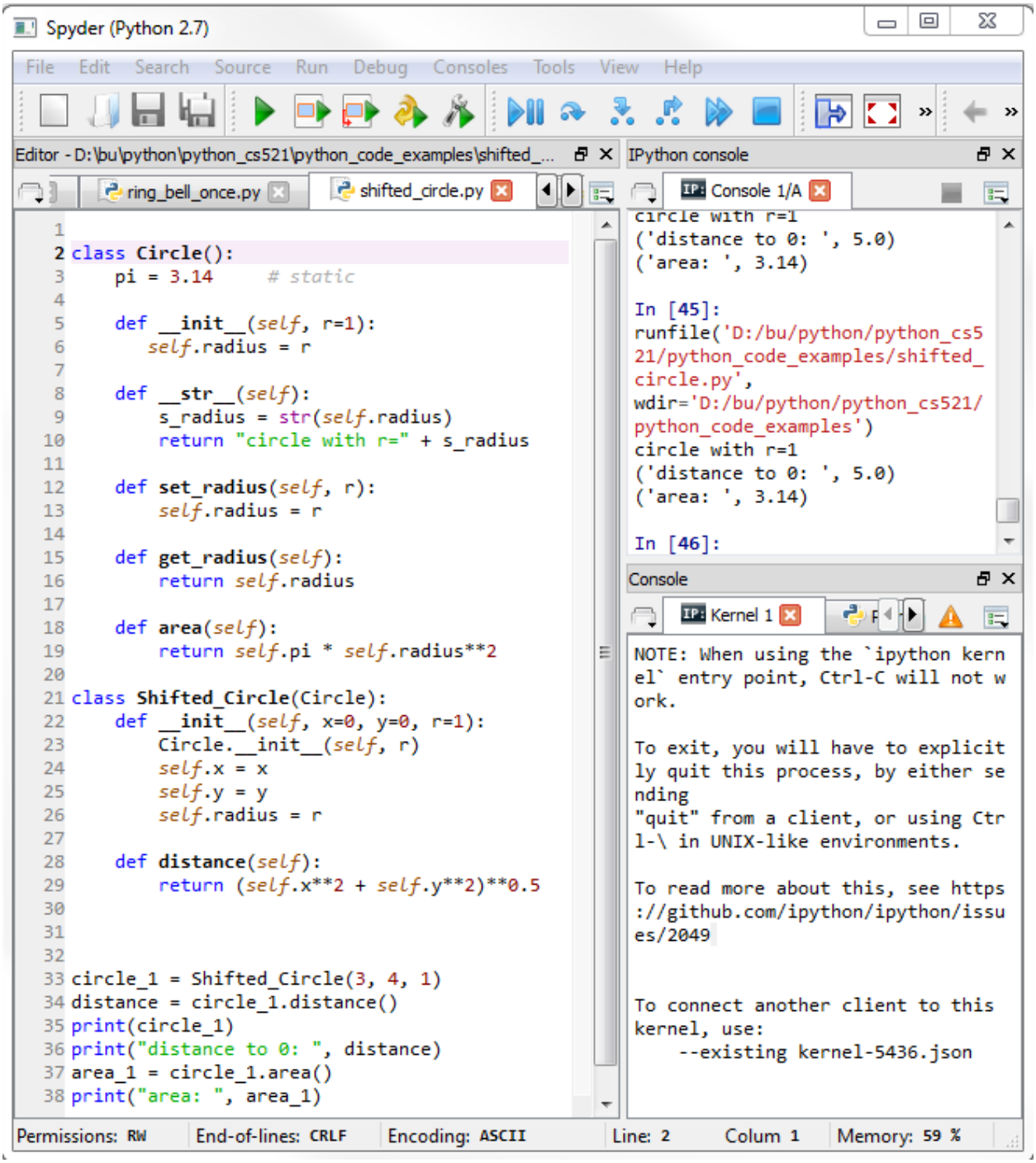
subclass superclass

```
Class Shifted_Circle(Circle):
```

```
# new static fields (optional)
```

```
def __init__():          # (new) constructor
def distance():          # new method(s)
```

Shifted_Circle() **Class Run**

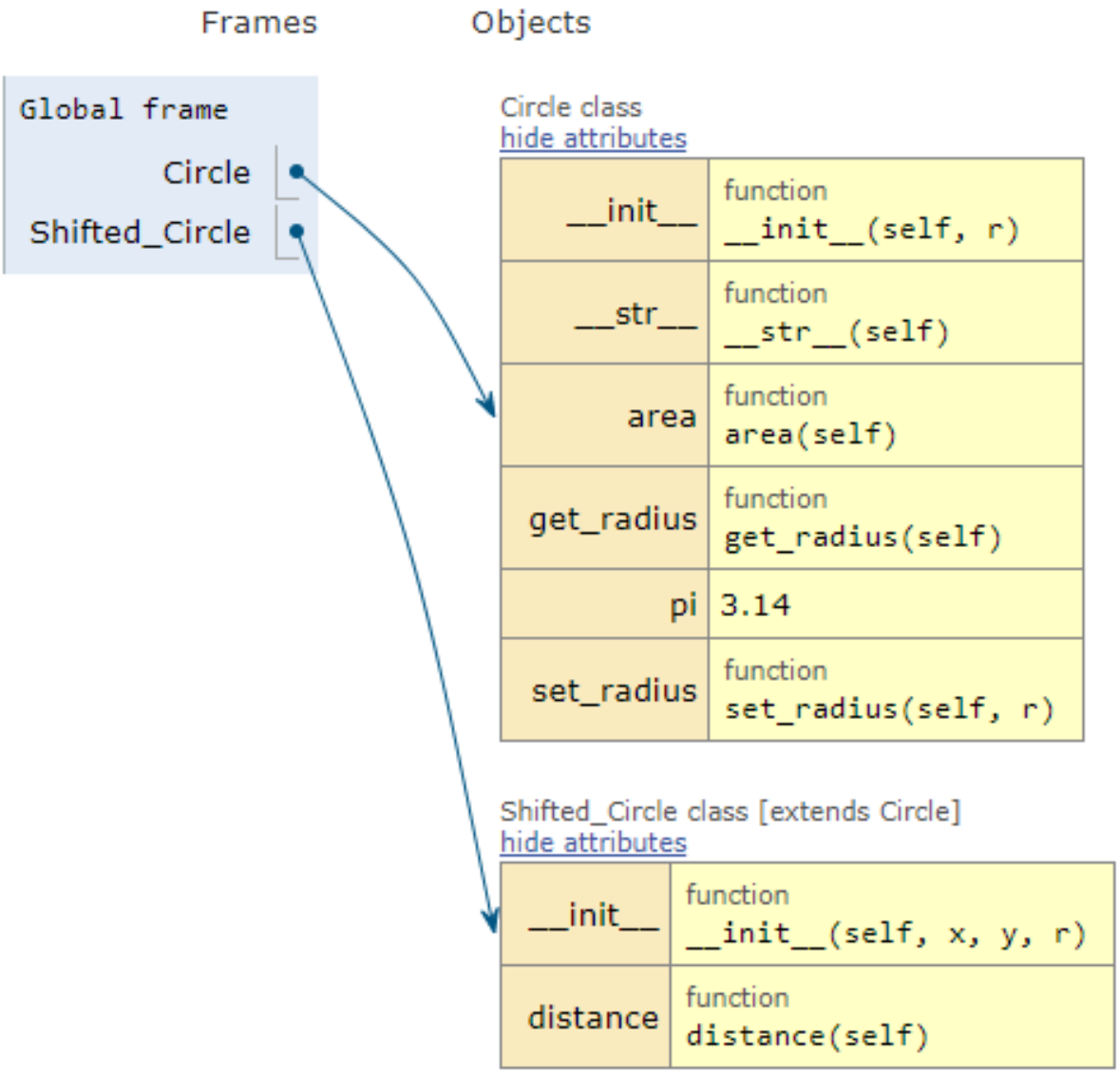


Shifted_Circle() **Attributes**

```
IPython console
Console 1/A
In [118]:

In [118]:

In [119]: Shifted_Circle.__bases__
Out[119]: (<class __main__.Circle at 0x000000000DC05F48>,)

In [120]: Shifted_Circle.__dict__
Out[120]:
{'__doc__': ' circle centered at (x,y) ',
 '__init__': <function __main__.__init__>,
 '__module__': '__main__',
 '__str__': <function __main__.__str__>,
 'distance': <function __main__.distance>}

In [121]: Shifted_Circle.__doc__
Out[121]: ' circle centered at (x,y) '

In [122]: Shifted_Circle.__module__
Out[122]: '__main__'

In [123]: Shifted_Circle.__name__
Out[123]: 'Shifted_Circle'

In [124]:
```

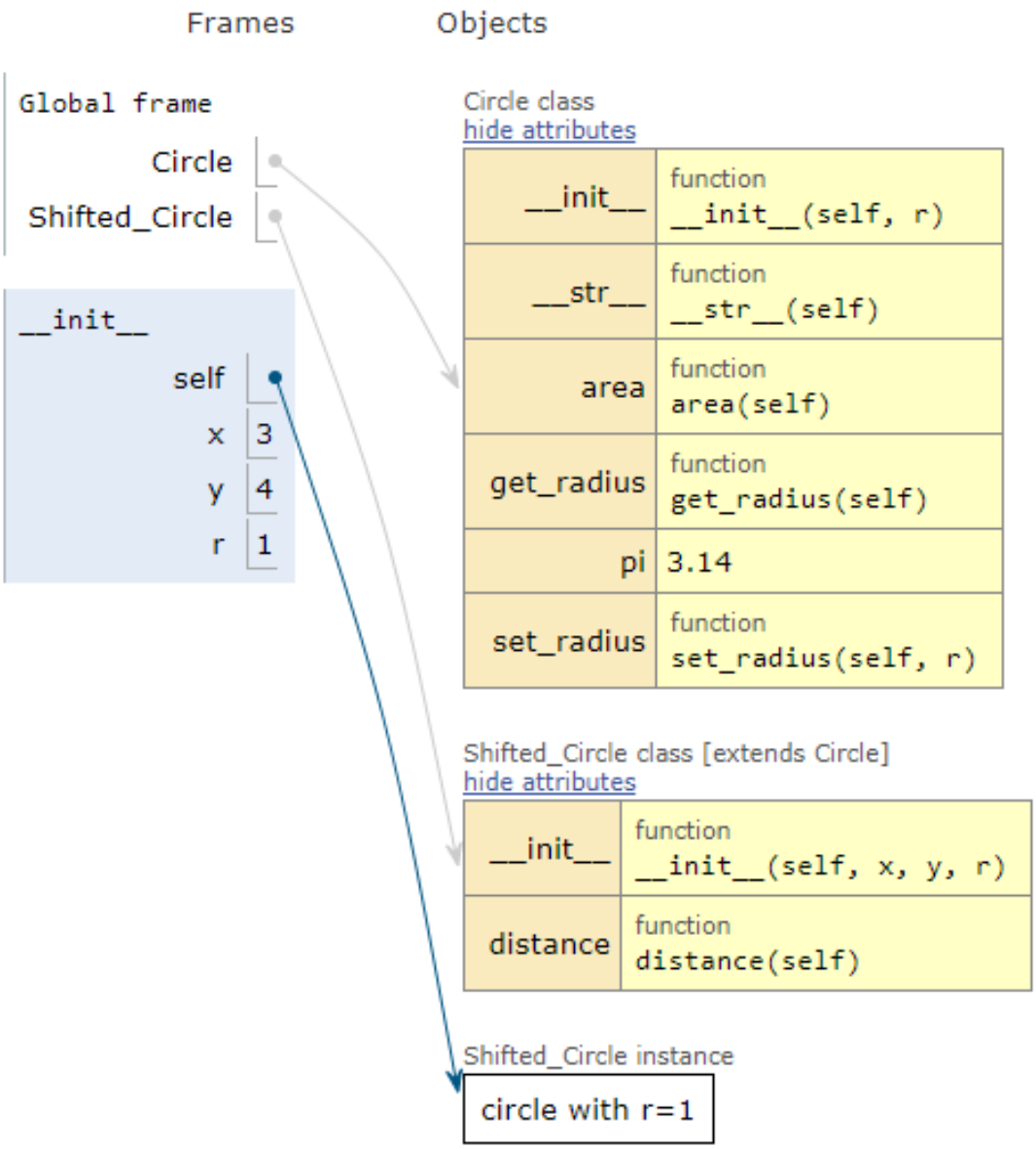
Shifted_Circle() **Class**

```
>>> import shifted_circle
```



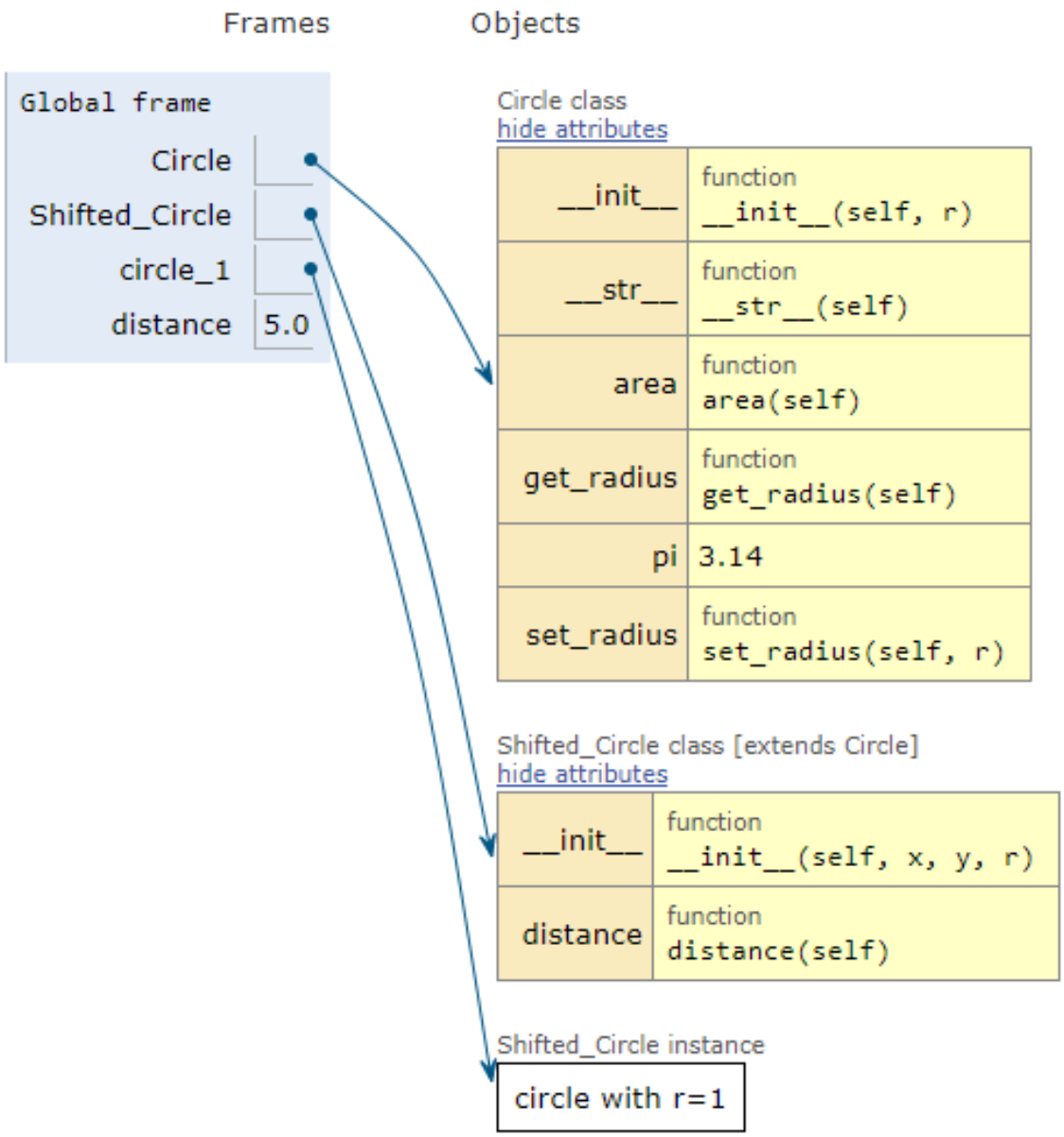
Shifted_Circle() Class (cont'd)

```
>>> circle_1 = Shifted_Circle(3, 4, 1)
```



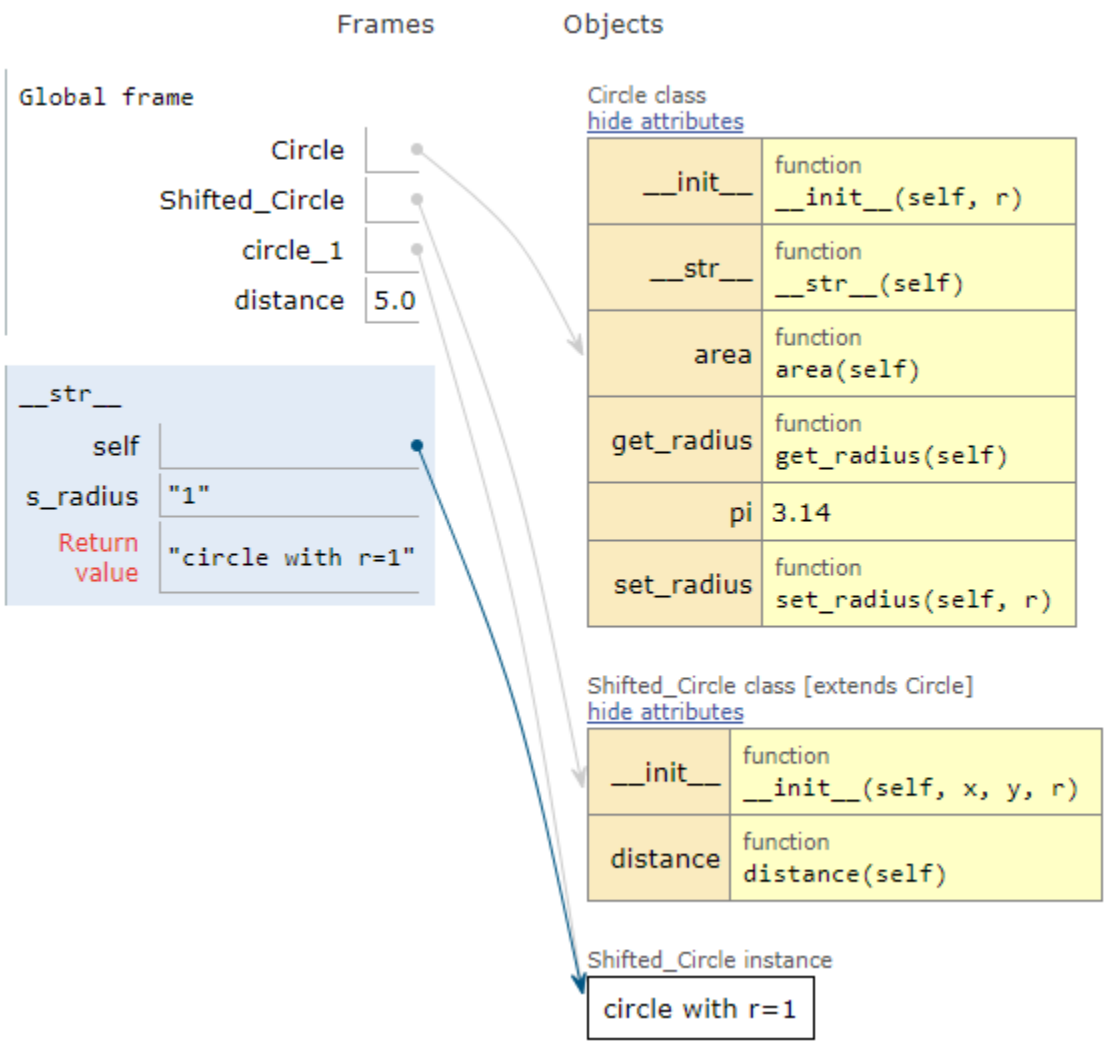
Shifted_Circle() Class (cont'd)

```
>>> distance = circle_1.get_distance()
```



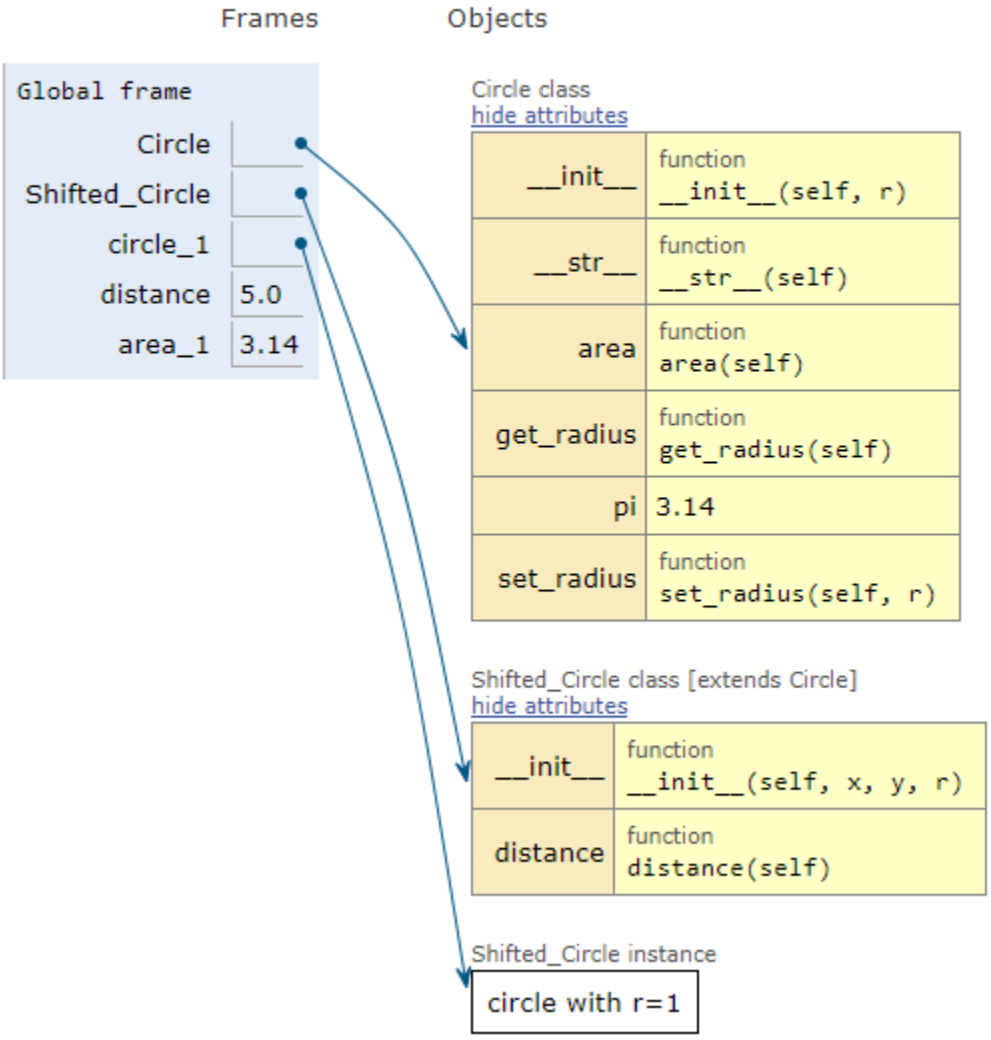
Shifted_Circle() Class (cont'd)

```
>>> print(circle_1)
```



Shifted_Circle() Class (cont'd)

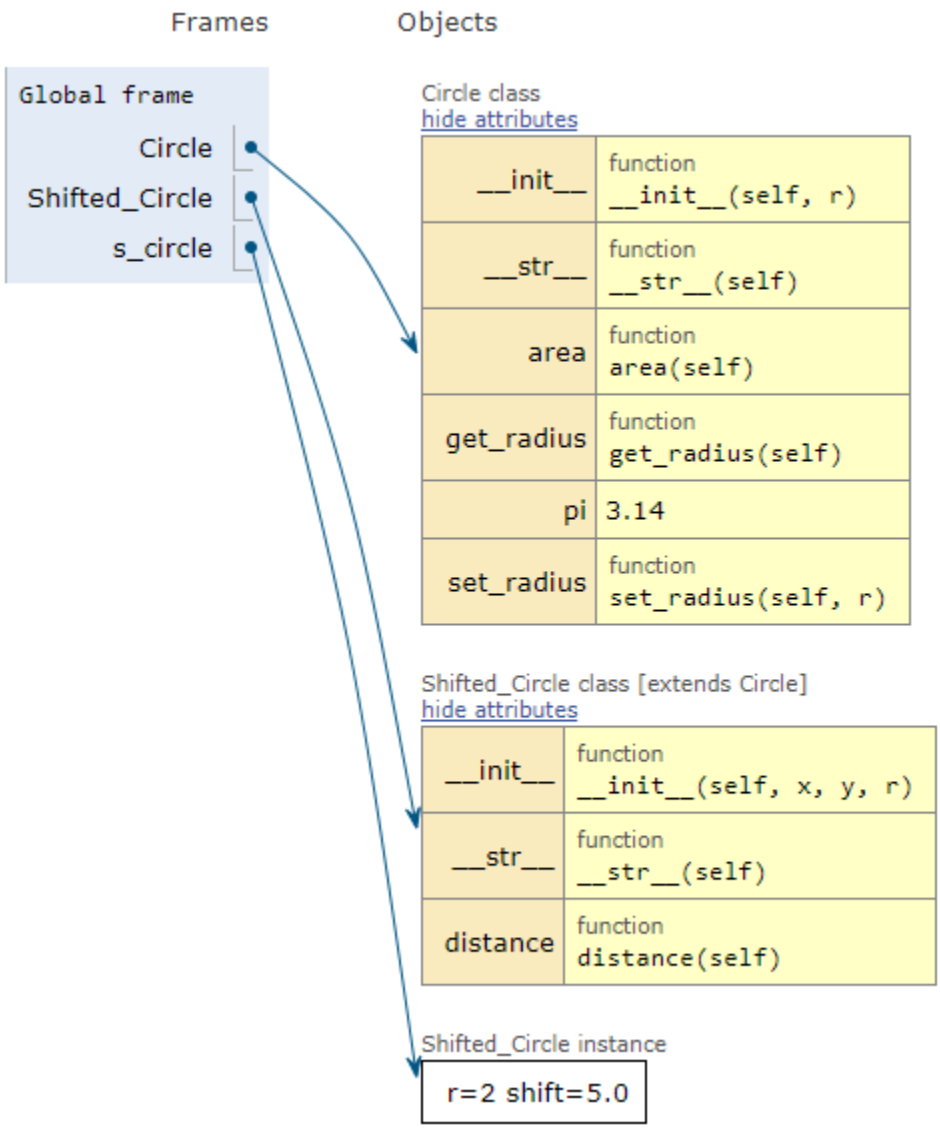
```
>>> area_1 = circle_1.area()
```



Inheritance

- extended class inherits *area*() method

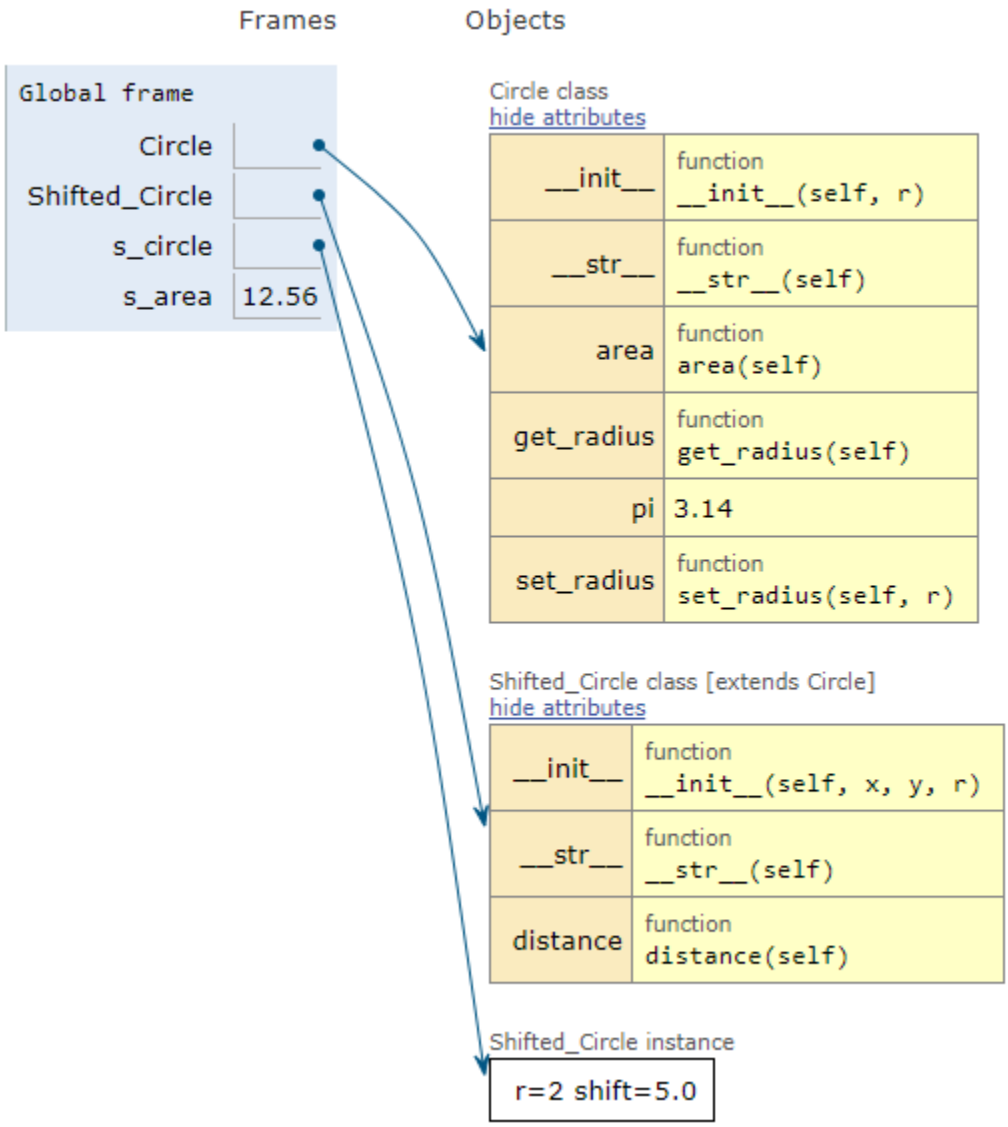
```
>>> s_circle = Shifted_Circle(3, 4, 2)
```



Inheritance (cont'd)

- extended class inherits *area*() method

```
>>> s_area = s_circle.area()
```



Overloading

- same method with different signatures
- set_radius(r) and *set_radius*(x, y, r) in extended class

```
>>> s_circle = Shifted_Circle(3, 4, 2)
>>> print(s_circle)
>>>
>>> #  set_radius()
>>> s_circle.set_radius(5)
>>> print(s_circle)
>>>
>>> #  set_radius()
>>> s_circle.set_radius(10, 12, 20)
>>> print(s_circle)
```

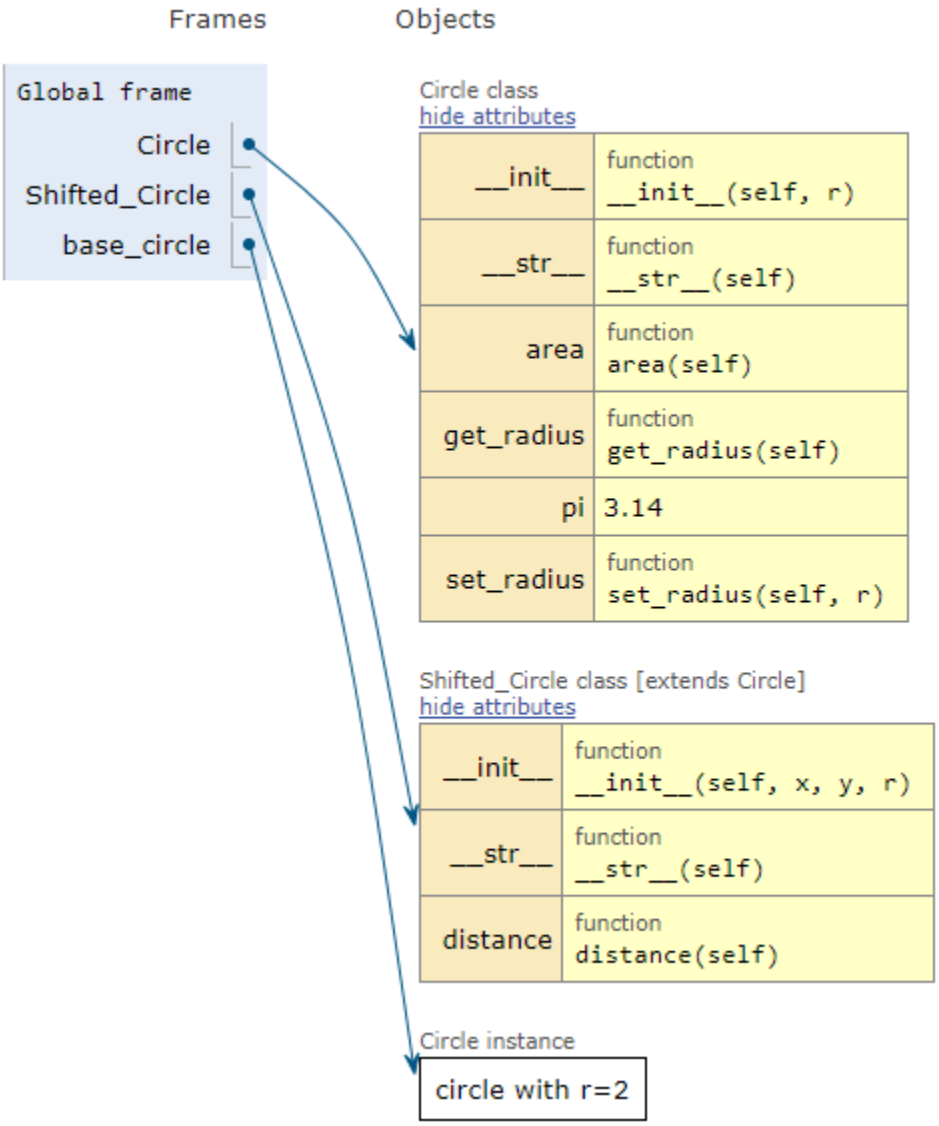
Overloading *set_radius*()

```
class Shifted_Circle(Circle):
    def __init__(self, x = 0, y = 0, r = 1):
        Circle.__init__(self, r)
        self.x  =  x
        self.y  =  y
        self.radius  =  r
    def distance(self):
        return (self.x**2 + self.y**2)**0.5
    def set_radius(self, x, y, r):
        self.x  =  x
        self.y  =  y
        self.radius = r
    def __str__(self):                    # representation.
        s_radius = str(self.radius)    # local variable
        s_distance = str(self.distance())
        return " r=" + s_radius + " shift=" + s_distance
```

Overriding

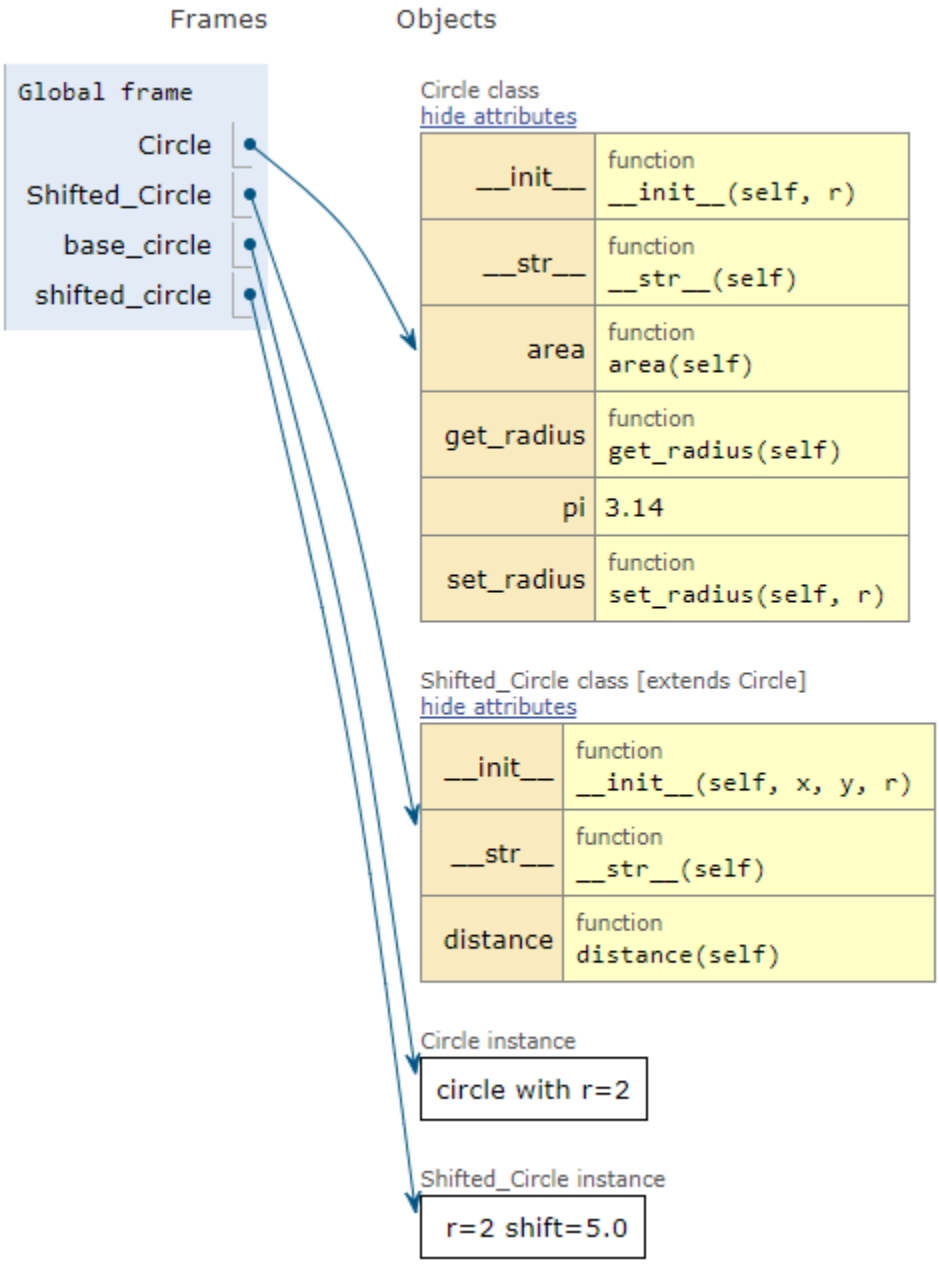
- override method(s) in base class

```
>>> base_circle = Circle(2)
>>> print(base_circle)
```



Overriding (cont'd)

```
>>> shifted_circle = Shifted_Circle(3,4,2)
>>> print(shifted_circle)
```



Overriding __*str*__() Method

```
class Shifted_Circle(Circle):
    def __init__(self, x = 0, y = 0, r = 1):
        Circle.__init__(self, r)
        self.x = x
        self.y = y
        self.radius = r

    def distance(self):
        return (self.x**2 + self.y**2)**0.5

    def __str__(self):
        s_radius = str(self.radius)
        s_distance = str(self.distance())
        return " r=" + s_radius + " shift=" + s_distance
```

Polymorphism

- *polys* (“many”), *morphe* (“form”)
- same interface for different types

	0	1	2	3	4	5	6	7	8	9	
[	‘M’,	‘o’,	‘z’,	‘z’,	‘a’,	‘r’,	‘e’,	‘l’,	‘l’,	‘a’	]
	−10	−9	−8	−7	-6	−5	−4	−3	−2	−1	

```
>>> y = [‘M’,‘o’,‘z’,‘z’,‘a’,‘r’,‘e’,‘l’,‘l’,a’][2]
```

	0	1	2	3	4	5	6	7	8	9	
(	‘M’,	‘o’,	‘z’,	‘z’,	‘a’,	‘r’,	‘e’,	‘l’,	‘l’,	‘a’	)
	−10	−9	−8	−7	−6	−5	−4	−3	−2	−1	

```
>>> y = (‘M’,‘o’,‘z’,‘z’,‘a’,‘r’,‘e’,‘l’,‘l’,a’)[2]
```

0	1	2	3	4	5	6	7	8	9
M	o	z	z	a	r	e	l	l	a
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1

```
>>> y = “Mozzarella”[2]
```

Polymorphism Example

```
class Animal():
    def __init__(self, name):    self.name = name
    def talk(self):    raise NotImplementedError("left to subclass")
```

```
class Cat(Animal):
    def talk(self):    return "Meou!"
```

```
class Dog(Animal):
    def talk(self):    return "Woof! Woof!"
```

```
>>> from Animal import Cat, Dog
>>> animals=[Cat('Missy'),Cat('Smokey'),Dog('Max')]
>>> for animal in animals:
        print animal.name + ':' + animal.talk()
>>> Missy: Meow!
>>> Smokey: Meow!
>>> Max: Woof! Woof!
```

Summary of Object-Oriented Concepts

- classes implement abstraction
- encapsulation: details are hidden
- applications use class methods
- subclasses inherit or override superclass methods
- polymorphism: same interface for different types

Review Problems

Interview Problem

- difference between overloading and overriding

Interview Problem

- explain inheritance with an example

Interview Problem

- which methods of Python are used to determine the type of instance and inheritance?

Interview Problem

- consider the case of multiple inheritance: a child class C is derived from two base classes say A and B as: class C(A, B)
- which parent class's method will be invoked by the interpreter whenever object of class C calls a method func() that is existing in both the parent classes say A and B and does not exist in class C?

Interview Problem

- how are *inheritance* and *overriding* methods related?