Data Structures in Python Chapter 1

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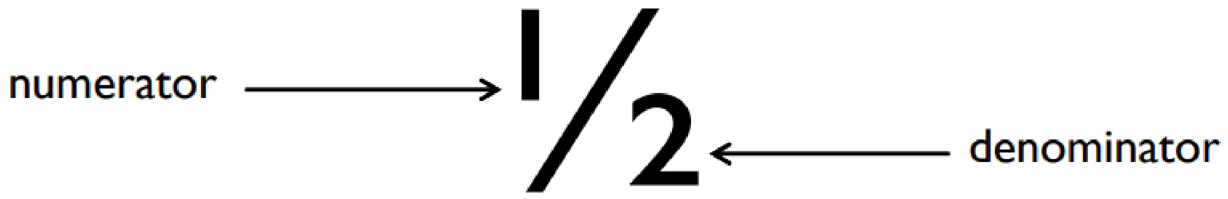
Agenda

- Topics:
  - Model of objects in memory
  - Constructor
  - Using the Fraction class
  - Overriding default behavior
    - __repr__
    - __str__

- References:
  - Problem Solving with Algorithms and Data Structures using Python
    - Chapter 1.13 Object-Oriented Programming in Python

Example: Fractions

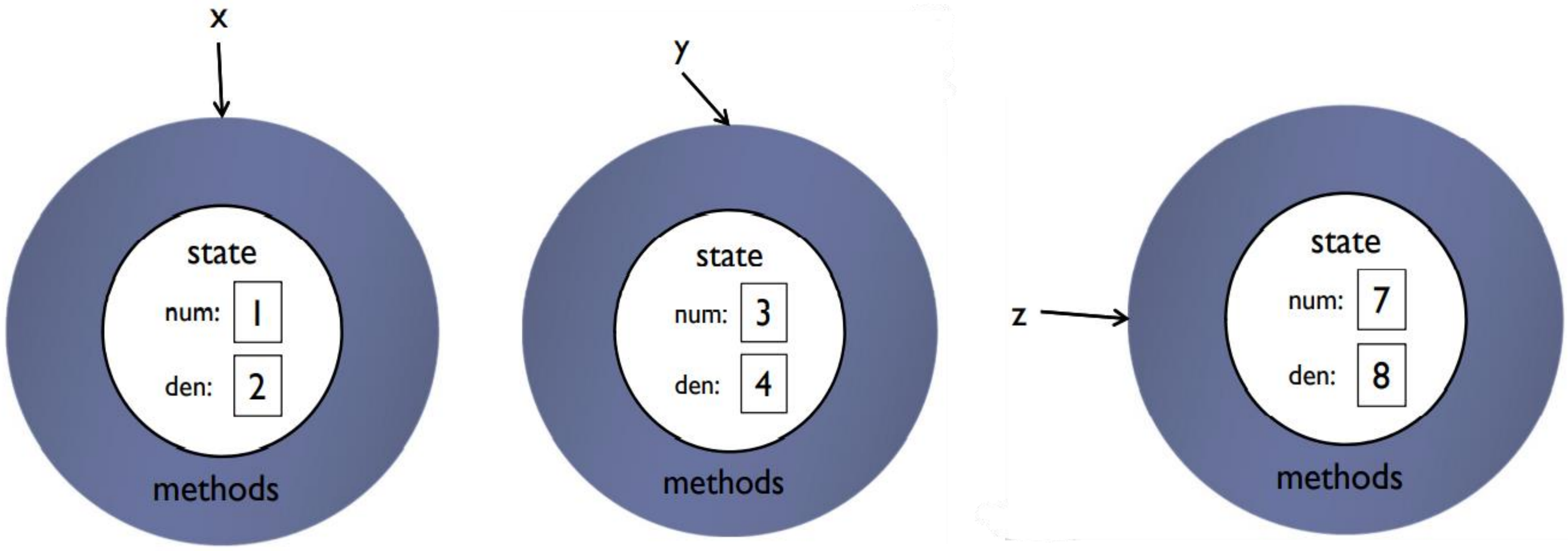
- Write a class to represent fractions in Python
  - create a fraction
  - add
  - subtract
  - multiply
  - divide
  - text representation



Model of objects in memory

```
from Fraction import Fraction

x = Fraction(1,2)
y = Fraction(3,4)
z = Fraction(7,8)
```



Constructor

- All classes must have a constructor
  - The constructor for a Fraction should store the numerator and the denominator

```
class Fraction:
    def __init__(self, top, bottom):
        self.num = top          #numerator
        self.den = bottom       #denominator
```

Using the Fraction class

- So far, we can create a Fraction object:

```
x = Fraction(3, 4)
```

- We can access the state variables directly
  - Although **not generally good** practice to do so

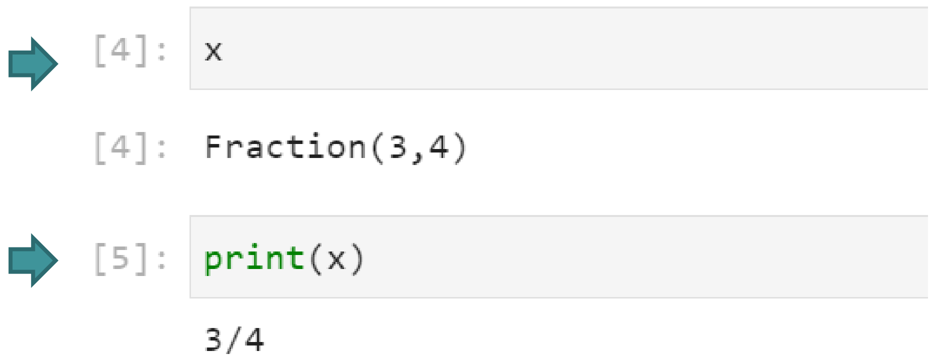
```
x.num        3
x.den        4
```

- What else can we do with Fractions?
  - Nothing yet. We need to write the functions first!

Overriding default behavior

- All classes get a number of methods provided by default
  - Since default behavior is not very useful, we should write our own versions of those methods. it is called "override"(재정의하다).
    - __repr__
    - __str__

x.num x.den	3 4
print(x)	3/4

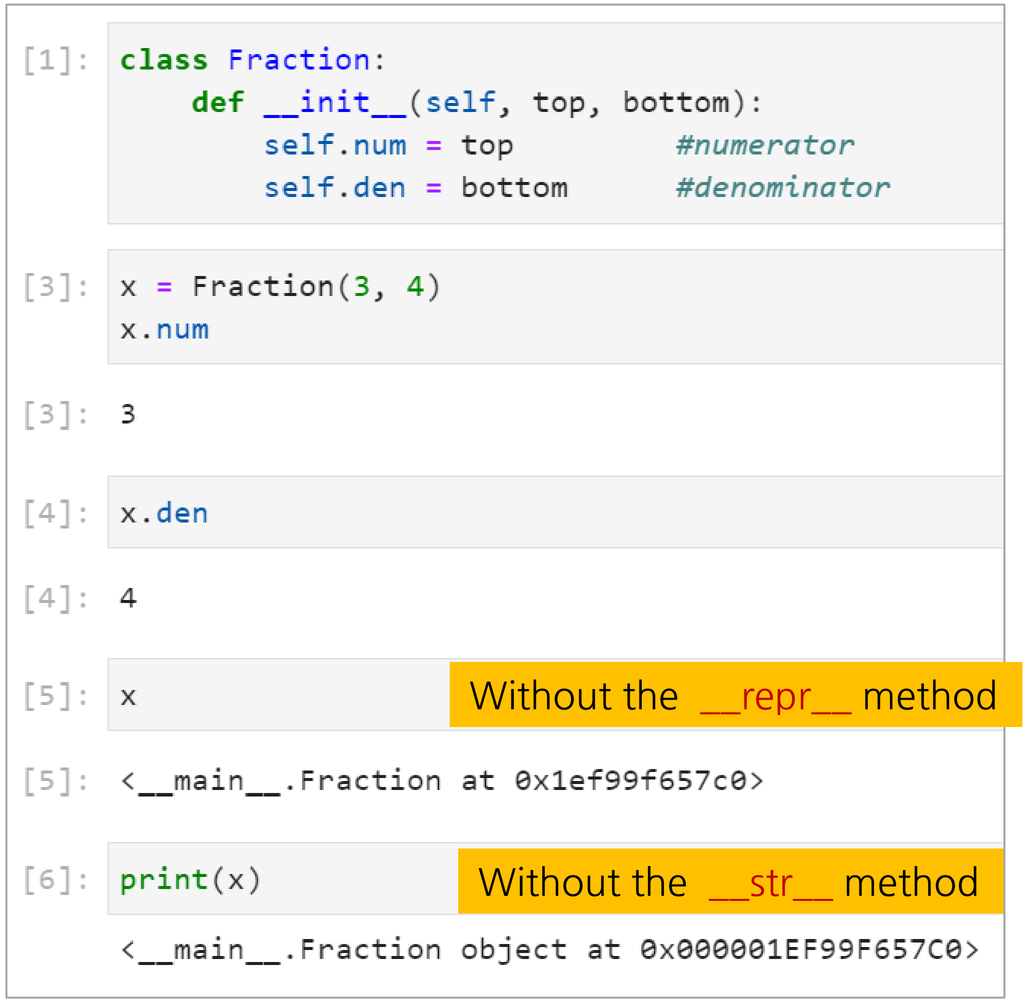


```
[4]: x

[4]: Fraction(3,4)

[5]: print(x)

3/4
```



```
[1]: class Fraction:
         def __init__(self, top, bottom):
             self.num = top          #numerator
             self.den = bottom       #denominator

[3]: x = Fraction(3, 4)
     x.num

[3]: 3

[4]: x.den

[4]: 4

[5]: x

[5]: <__main__.Fraction at 0x1ef99f657c0>

[6]: print(x)

     <__main__.Fraction object at 0x000001EF99F657C0>
```

Aside: Use of string formatting syntax

- Often we want to use a string that combines literal text and information from variables

```
name = 'Andrew'
greeting = 'Hello ' + name + '. How are you?'
```

- We can use string formatting to perform this task
  - Use curly braces within the string to signify a variable to be replaced

```
host = 'Andrew'
greeting = 'Hello {one}. How are you?'.format(one=host)
```

  - We can put the argument position in the curly braces

```
host = 'Park'
guest = 'Lee'
greeting = 'Hello {one} {two}'.format(two=guest, one=host)
```

```
greeting = 'Hello {0} {1}'.format(host, guest)
```

```
greeting = f'Hello {host} {guest}'
```

__repr__

- The __repr__() produces a string that unambiguously describes the object.
  - All classes should have a __repr__ function implemented.
  - Ideally, the representation could be used to create the object

```
class Fraction:
    def __init__ (self, top, bottom):
        self.num = top
        self.den = bottom
    def __repr__ (self):
        return 'Fraction({},{})'.format(self.num, self.den)
```

- With __repr__(), we can use the print function to print the object
  - Using __repr__(), but not __str__()

```
x = Fraction(2,3)
x
```

```
Fraction(2,3)
```

```
x = Fraction(2,3)
print(x)
```

```
Fraction(2,3)
```

__str__

- The __str__() method returns a string representing the object
  - By default, it calls the **__repr__** method
  - The __str__ method should focus on being human readable
  - We should implement a version with a natural representation:

```
def __str__(self):
    return str(self.num) + '/' + str(self.den)
```

- With __str__(), we can use the print function to print the object
  - Using __repr__(), and __str__()

```
x = Fraction(2,3)
x
```

```
Fraction(2,3)
```

```
x = Fraction(2,3)
print(x)
```

```
2/3
```

__str__ and __repr__

- What is the difference between the __str__ and __repr__ methods of a Python object?
  - In short __repr__ goal is to be unambiguous and __str__ is to be readable.
  - The official Python documentation says:
    - __repr__ is used to compute the “official” string representation of an object.
    - __str__ is used to compute the “informal” string representation of an object.
  - The print statement and str() built-in function uses __str__
  - The repr() built-in function uses __repr__ to display the object.

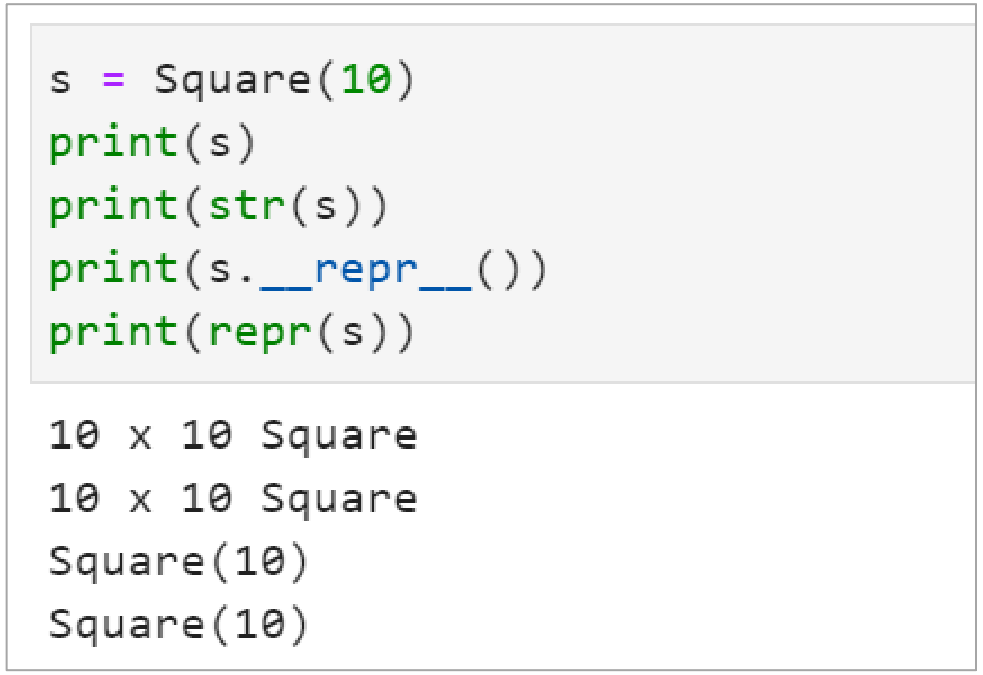
```
s1 = Square(10)
str(s1)                    '10 x 10 Square'
```

```
repr(s1)                   'Square(10)'
```

- Resource:
  - https://stackoverflow.com/questions/1436703/what-is-the-difference-between-str-and-repr

Exercise 1

1. Write the__str__ and __repr__ method for the Square class in Geometry.py.
2. Why would it be useful to implement a __str__ method?



```
s = Square(10)
print(s)
print(str(s))
print(s.__repr__())
print(repr(s))
```

```
10 x 10 Square
10 x 10 Square
Square(10)
Square(10)
```

Exercise 2

- Consider the Circle class which we developed previously:
  - Modify the constructor with default values of 0 for the radius
  - Write the __str__ method and the __repr__ method
  - Sample Run:

```
c1 = Circle(10)

str(s1)          'A circle with a radius of 10cm'
```

```
repr(s1)         'Circle(10)'
```

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