61A Lecture 16

Announcements

String Representations

String Representations

An object value should behave like the kind of data it is meant to represent

For instance, by producing a string representation of itself

Strings are important: they represent language and programs

In Python, all objects produce two string representations:

- The **str** is legible to humans
- The **repr** is legible to the Python interpreter

The **str** and **repr** strings are often the same, but not always

The repr String for an Object

The **repr** function returns a Python expression (a string) that evaluates to an equal object

```
repr(object) -> string

Return the canonical string representation of the object.
For most object types, eval(repr(object)) == object.
```

The result of calling **repr** on a value is what Python prints in an interactive session

```
>>> 12e12
120000000000000.0
>>> print(repr(12e12))
120000000000000.0
```

Some objects do not have a simple Python-readable string

```
>>> repr(min)
'<built-in function min>'
```


The str String for an Object

Human interpretable strings are useful as well:

```
>>> from fractions import Fraction
>>> half = Fraction(1, 2)
>>> repr(half)
'Fraction(1, 2)'
>>> str(half)
'1/2'
```

The result of calling **str** on the value of an expression is what Python prints using the **print** function:

```
>>> print(half)
1/2
```

(Demo)

Discussion

Human interpretable strings are useful as well:

```
>>> from fractions import Fraction
>>> half = Fraction(1, 2)
>>> repr(today)
'Fraction(1, 2)'
>>> str(today)
'1/2'
```

The result of calling **str** on the value of an expression is what Python prints using the **print** function:

```
>>> print(half)
1/2
```

(Demo)

Polymorphic Functions

Polymorphic Functions

Polymorphic function: A function that applies to many (poly) different forms (morph) of data

str and **repr** are both polymorphic; they apply to any object

repr invokes a zero-argument method __repr__ on its argument

```
>>> half.__repr__()
'Fraction(1, 2)'
```

str invokes a zero-argument method __str__ on its argument

```
>>> half.__str__()
'1/2'
```


Implementing repr and str

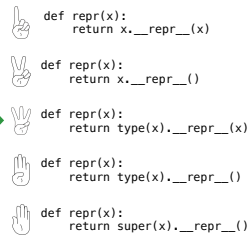
The behavior of **repr** is slightly more complicated than invoking __repr__ on its argument:

- An instance attribute called __repr__ is ignored! Only class attributes are found
- *Question*: How would we implement this behavior?

The behavior of **str** is also complicated:

- An instance attribute called __str__ is ignored
- If no __str__ attribute is found, uses **repr** string
- *Question*: How would we implement this behavior?
- **str** is a class, not a function

(Demo)



Interfaces

Message passing: Objects interact by looking up attributes on each other (passing messages)

The attribute look-up rules allow different data types to respond to the same message

A **shared message** (attribute name) that elicits similar behavior from different object classes is a powerful method of abstraction

An interface is a set of shared messages, along with a specification of what they mean

Example:

Classes that implement __repr__ and __str__ methods that return Python-interpretable and human-readable strings implement an interface for producing string representations

(Demo)

Special Method Names

Special Method Names in Python

Certain names are special because they have built-in behavior

These names always start and end with two underscores

__init__	Method invoked automatically when an object is constructed
__repr__	Method invoked to display an object as a Python expression
__add__	Method invoked to add one object to another
__bool__	Method invoked to convert an object to True or False
__float__	Method invoked to convert an object to a float (real number)

```
>>> zero, one, two = 0, 1, 2
>>> one + two
3
>>> bool(zero), bool(one)
(False, True)
```

Same behavior using methods

```
>>> zero, one, two = 0, 1, 2
>>> one.__add__(two)
3
>>> zero.__bool__(), one.__bool__()
(False, True)
```


Special Methods

Adding instances of user-defined classes invokes either the __add__ or __radd__ method

```
>>> Ratio(1, 3) + Ratio(1, 6)
Ratio(1, 2)

>>> Ratio(1, 3).__add__(Ratio(1, 6))
Ratio(1, 2)

>>> Ratio(1, 6).__radd__(Ratio(1, 3))
Ratio(1, 2)
```

http://getpython3.com/diveintopython3/special-method-names.html

http://docs.python.org/py3k/reference/datamodel.html#special-method-names

(Demo)

Generic Functions

Goal: Write a function that operates on two or more arguments of different types

Type Dispatching: Inspect the type of an argument in order to select behavior

Type Coercion: Convert one value to match the type of another

(Demo)

Property Methods

Property Methods

Often, we want the value of instance attributes to stay in sync

For example, what if we wanted a Ratio to keep its proportion when its numerator changes

```
>>> f = Ratio(3, 5)
>>> f.gcd
1
>>> f.numer = 6
>>> f.denom
10
>>> f.gcd
2
```

No method calls!

$$\frac{\cancel{6}}{\cancel{10}}$$

The @property decorator on a method designates that it will be called whenever it is looked up on an instance

A @<attribute>.setter decorator on a method designates that it will be called whenever that attribute is assigned. <attribute> must be an existing property method.

(Demo)