Representation
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.

\[
\text{repr(object)} \rightarrow \text{string}
\]

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:

```python
>>> 12e12
12000000000000.0
>>> print(repr(12e12))
12000000000000.0
```

Some objects do not have a simple Python-readable string:

```python
>>> repr(min)
'\langle built-in function min\rangle'
```
The str String for an Object

Human interpretable strings are useful as well:

```python
>>> 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:

```python
>>> print(half)
1/2
```
F-Strings
### String Interpolation in Python

String interpolation involves evaluating a string literal that contains expressions.

**Using string concatenation:**

```python
>>> from math import pi
>>> 'pi starts with ' + str(pi) + '...'
'pi starts with 3.141592653589793...

>>> print('pi starts with ' + str(pi) + '...')
pi starts with 3.141592653589793...
```

**Using string interpolation:**

```python
>>> f'pi starts with {pi}...'
'pi starts with 3.141592653589793...

>>> print(f'pi starts with {pi}...')
pi starts with 3.141592653589793...
```

The result of evaluating an f-string literal contains the str string of the value of each sub-expression. Sub-expressions are evaluated in the current environment.
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

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

`str` invokes a zero-argument method `__str__` on its argument

```python
>>> half.__str__()
'1/2'
```
Implementing repr and str

The behavior of \texttt{repr} is slightly more complicated than invoking \texttt{__repr__} on its argument:
- An instance attribute called \texttt{__repr__} is ignored! Only class attributes are found
- \textit{Question:} How would we implement this behavior?

The behavior of \texttt{str} is also complicated:
- An instance attribute called \texttt{__str__} is ignored
- If no \texttt{__str__} attribute is found, uses \texttt{repr} string
  - \textit{(By the way, \texttt{str} is a class, not a function)}
- \textit{Question:} How would we implement this behavior?

(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)

```python
>>> zero, one, two = 0, 1, 2
>>> one + two
3
>>> bool(zero), bool(one)
(False, True)
>>> zero.__bool__(), one.__bool__()
(False, True)
```
Adding instances of user-defined classes invokes either the `__add__` or `__radd__` method.

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

(Demo)
Generic Functions

A polymorphic function might take 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

```python
>>> Ratio(1, 3) + 1
Ratio(4, 3)

>>> 1 + Ratio(1, 3)
Ratio(4, 3)

>>> from math import pi
>>> Ratio(1, 3) + pi
3.4749259869231266

(Demo)