61A Lecture 18

Monday, October 8

Relationship to the Python Object System

Bonus Material

Object attributes are stored as dictionaries

Some special names, __<name>__, require special handling

An object has an "attribute" called __dict__ that is a dictionary of its user-defined instance attributes

Demo

In Python, classes have classes too

The equivalent of init_instance can be customized (metaclass)

Generic Functions

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- String representations of objects
- Multiple representations of abstract data types
- Property methods

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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**

When the "str" and "repr" **strings are the same,** we're doing **something right** in our programming language!

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

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The behavior of str:

- An instance attribute called __str__ is ignored
- If no __str__ attribute is found, uses repr string (demo)
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- str is a class, not a function

Interfaces

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

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Message passing allows **different data types** to respond to the **same message**

A shared message 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**

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

Multiple Representations of Abstract Data

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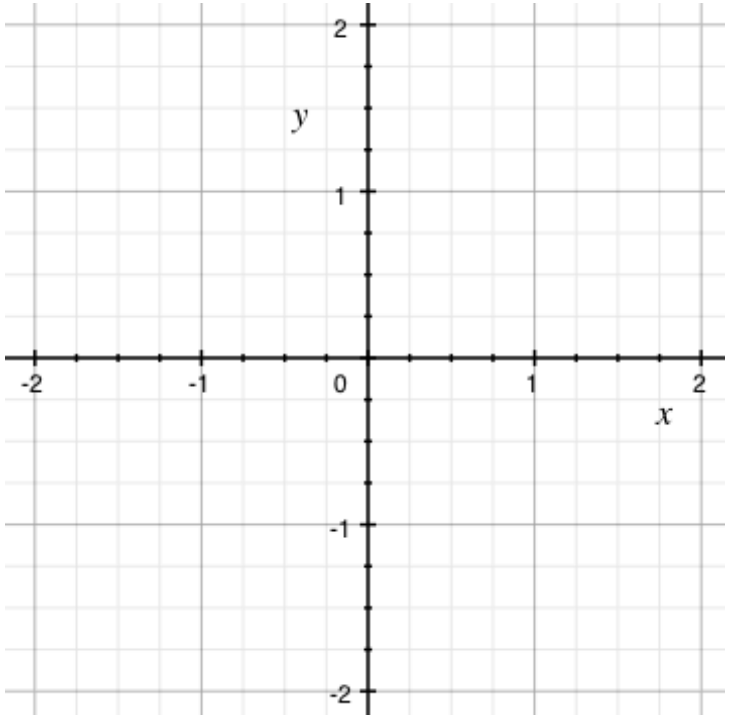
Rectangular and polar representations for complex numbers

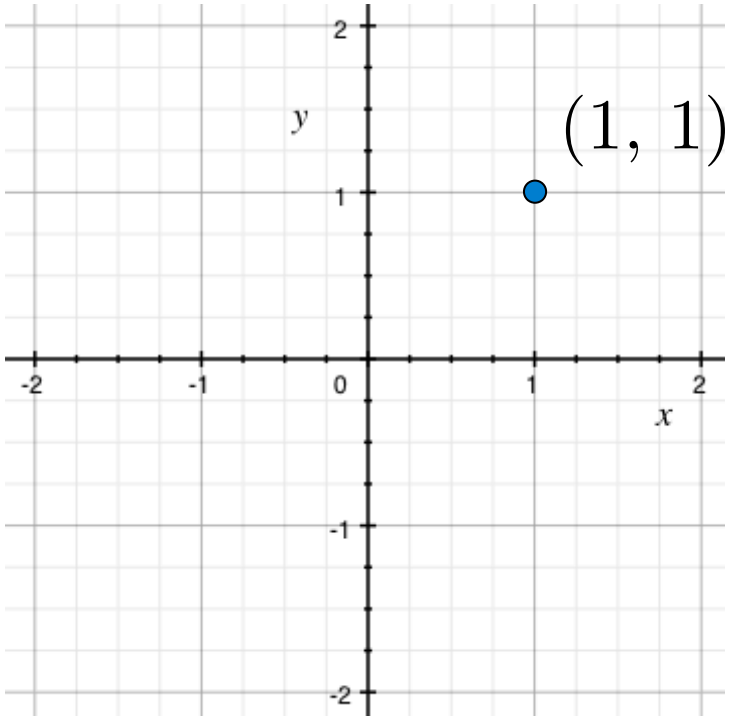
Multiple Representations of Abstract Data

Rectangular and polar representations for complex numbers



Multiple Representations of Abstract Data

Rectangular and polar representations for complex numbers



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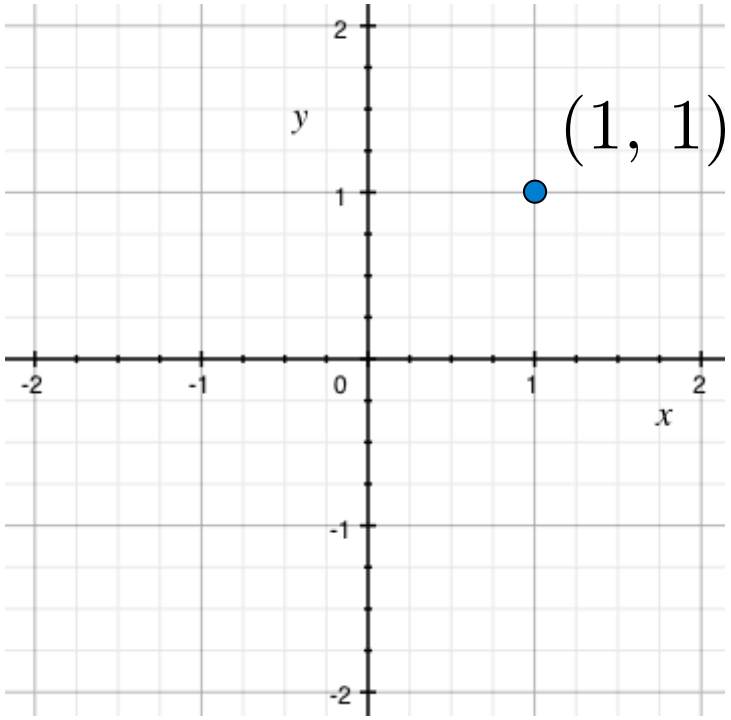

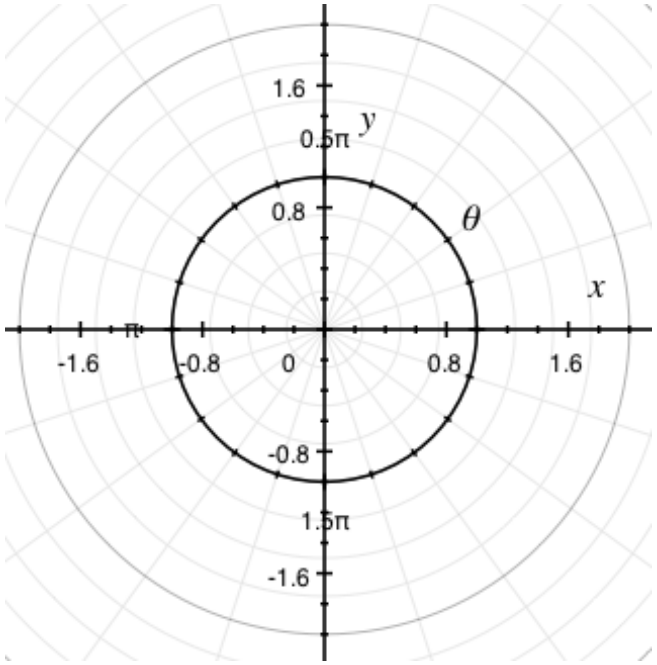

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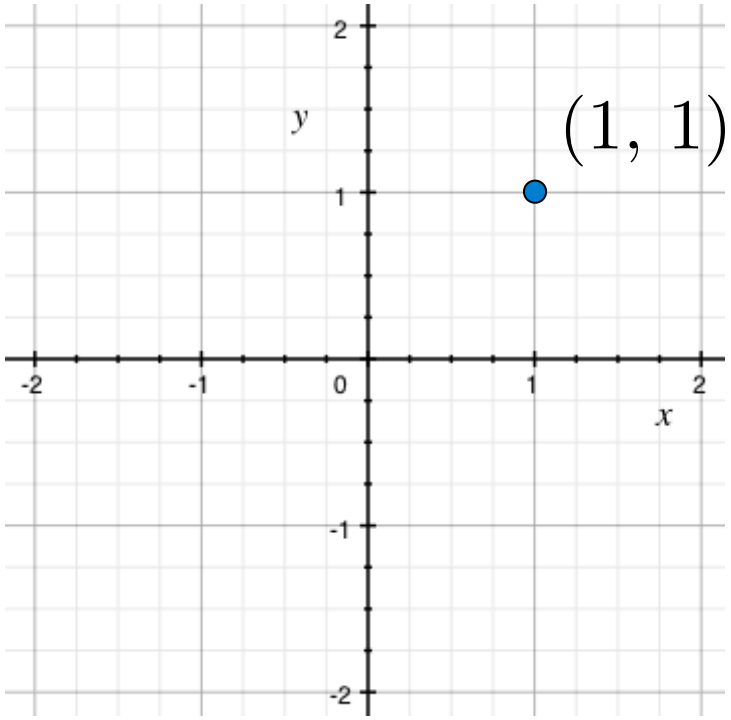

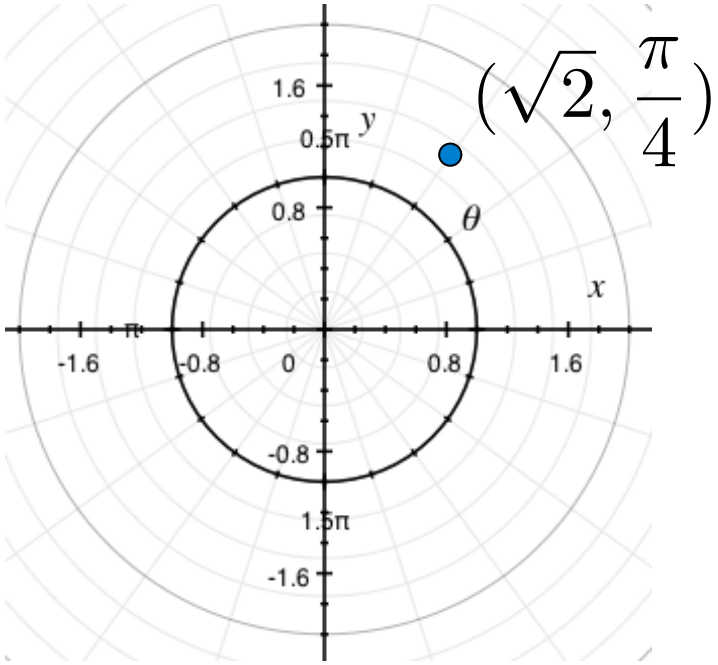

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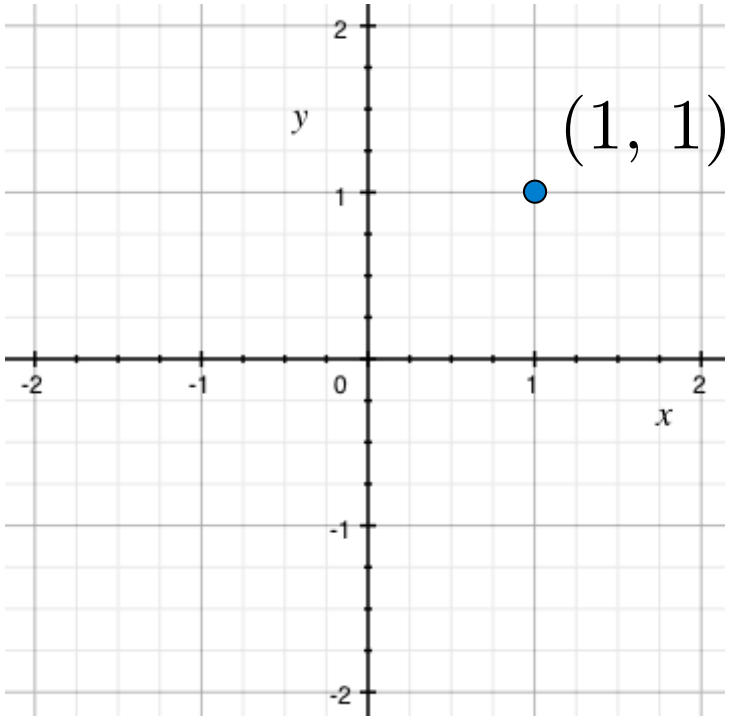

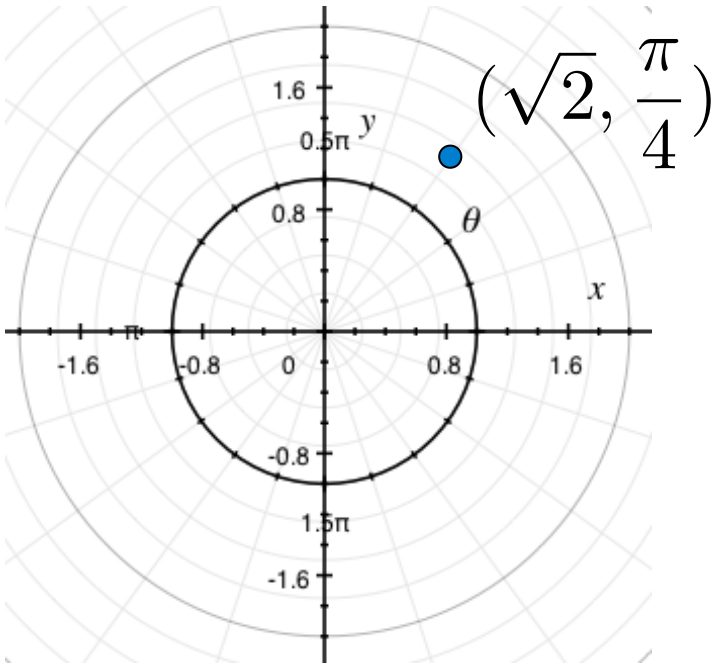

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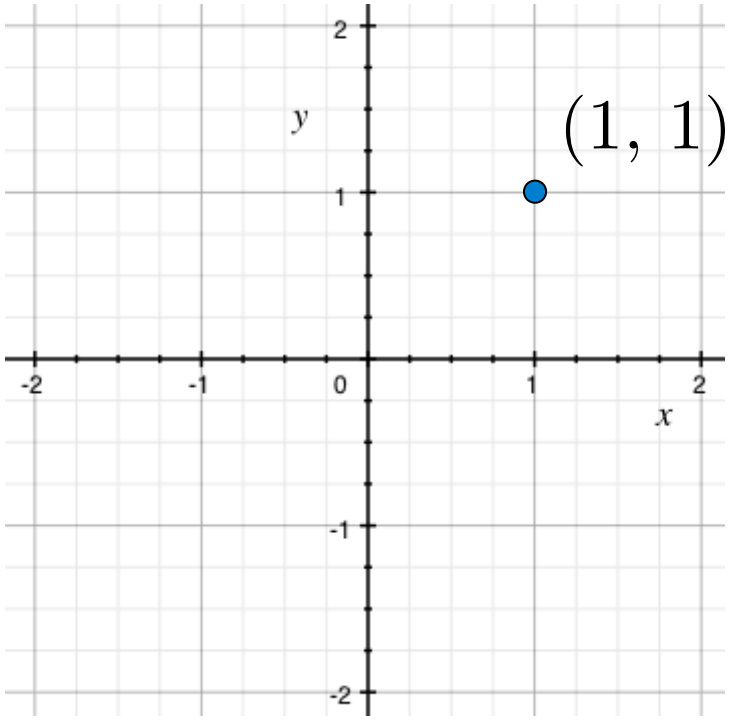

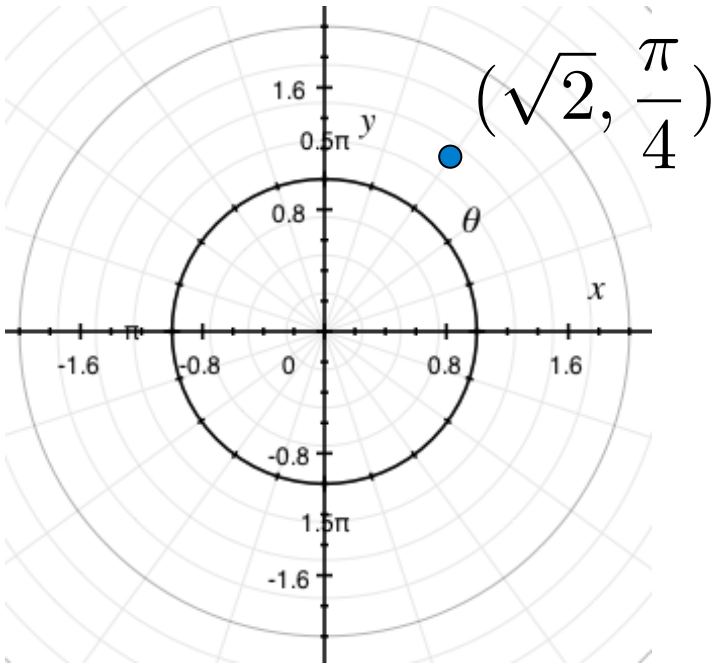

Most operations don't care about the representation

Some mathematical operations are easier on one than the other

Arithmetic Abstraction Barriers

Rectangular representation

Polar representation

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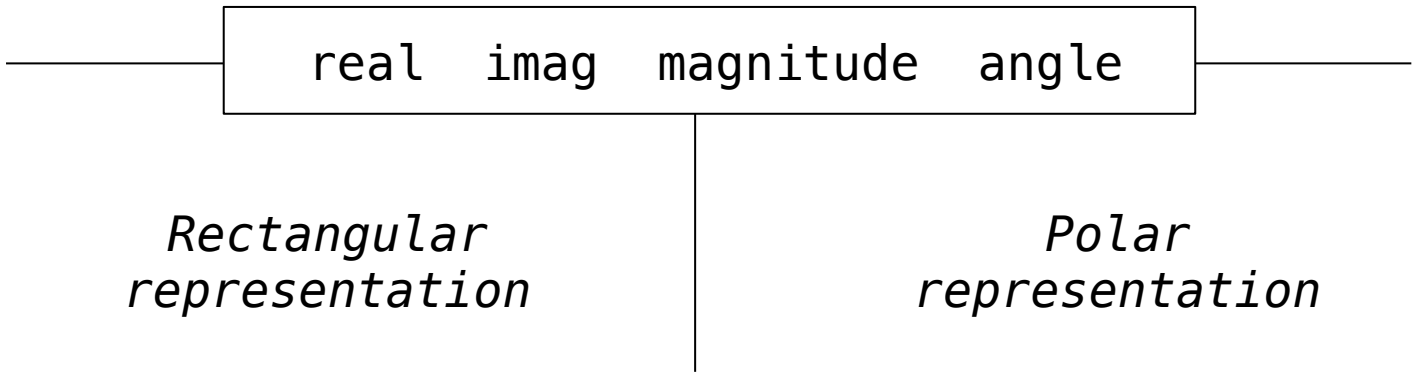

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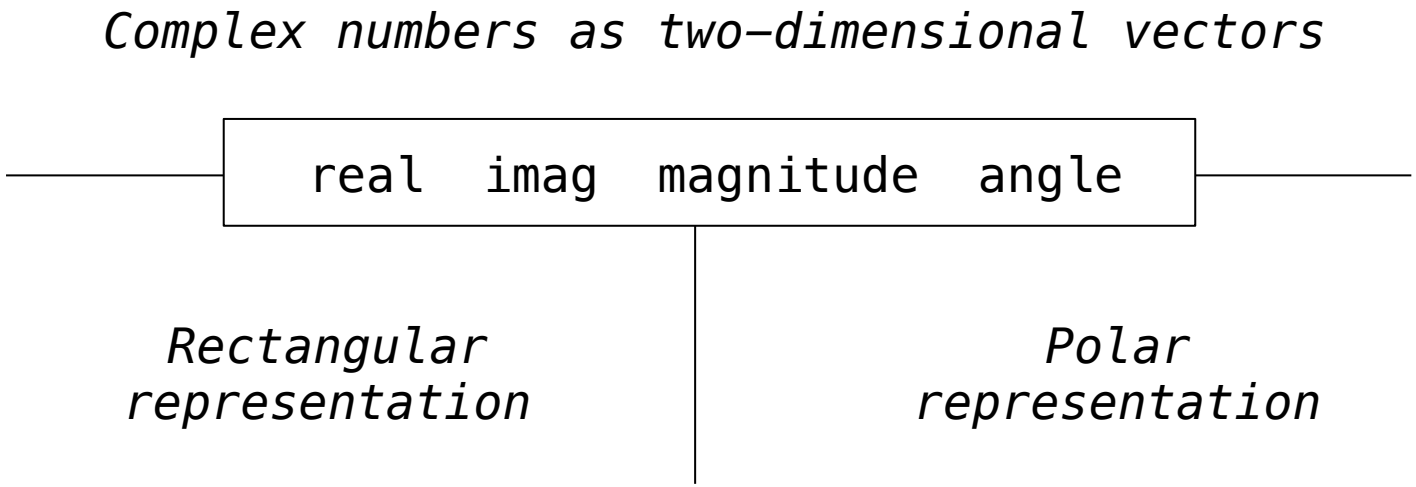

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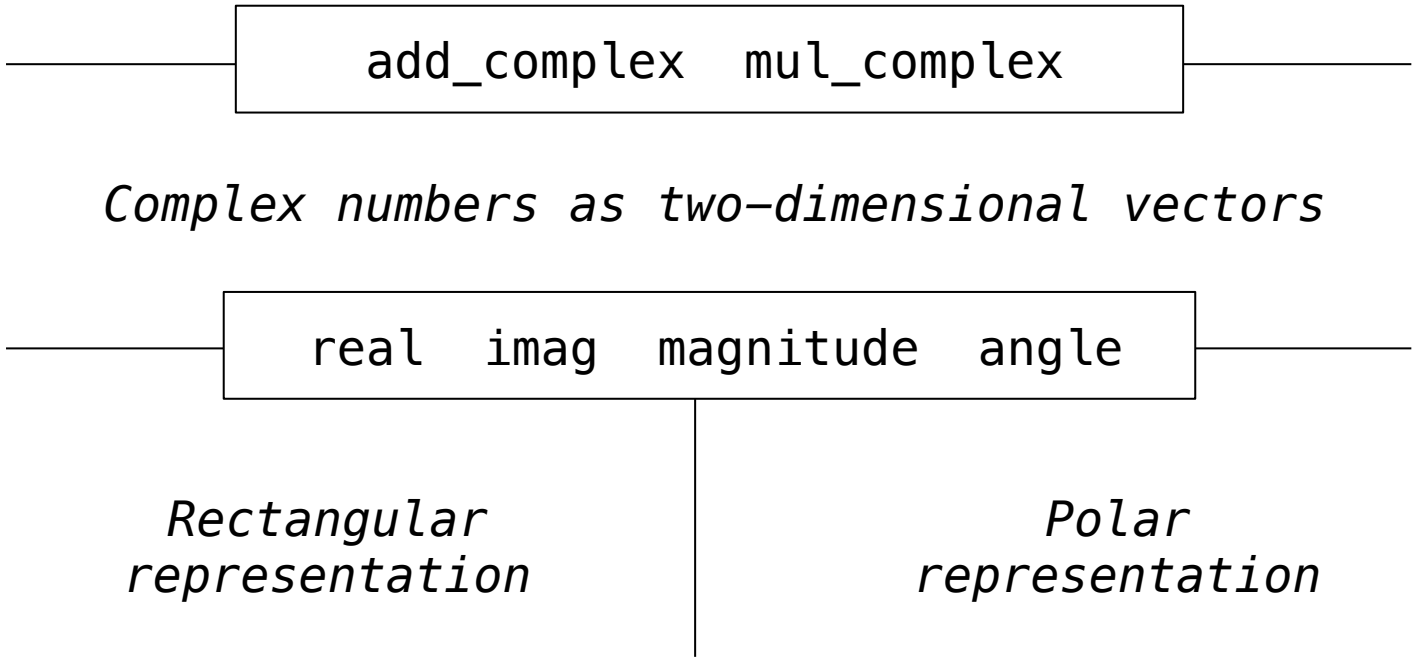

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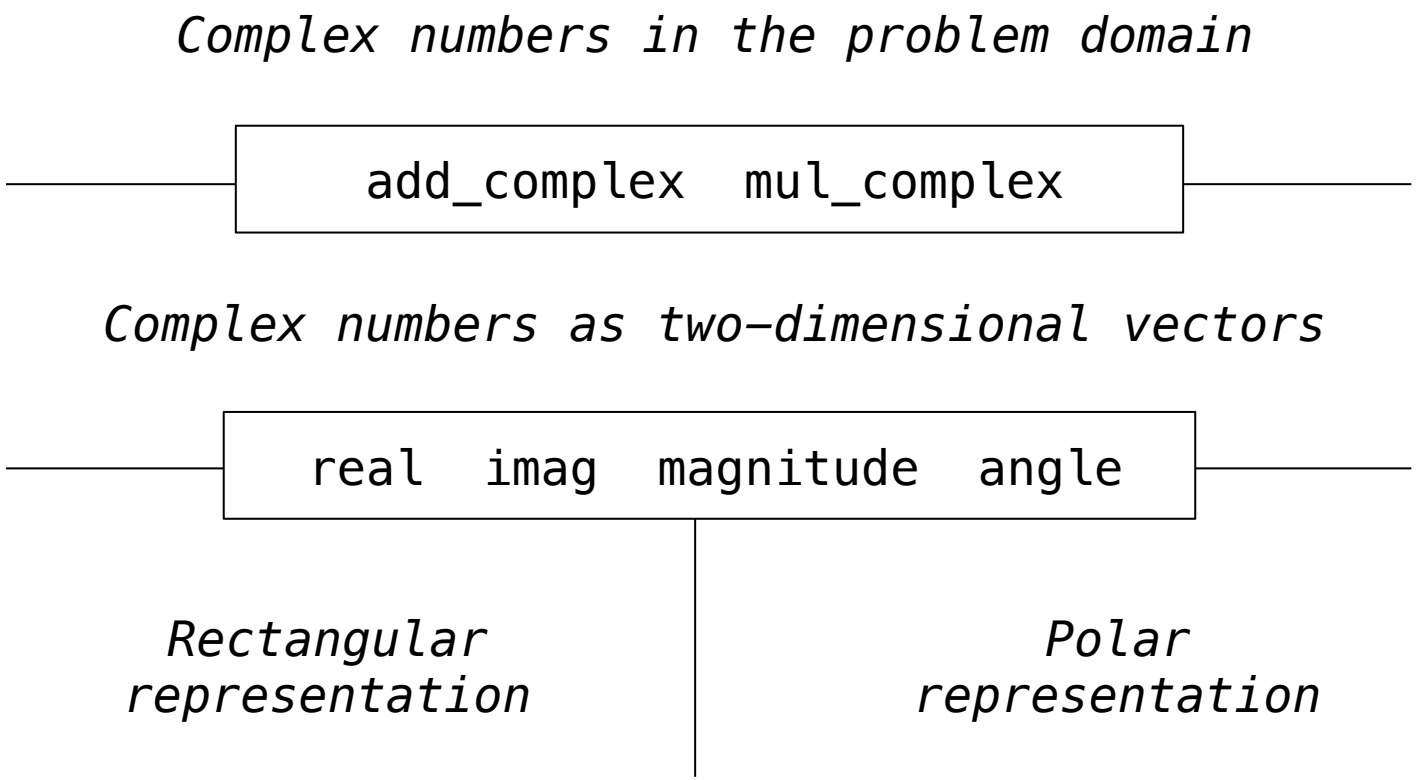

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>>> def add_complex(z1, z2):
        return ComplexRI(z1.real + z2.real,
                         z1.imag + z2.imag)

>>> def mul_complex(z1, z2):
        return ComplexMA(z1.magnitude * z2.magnitude,
                         z1.angle + z2.angle)
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>>> f.denom -= 3
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    def __init__(self, real, imag):
        self.real = real
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class ComplexRI(object):

    def __init__(self, real, imag):
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    @property
    def magnitude(self):
        return (self.real ** 2 + self.imag ** 2) ** 0.5
```

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    @property
    def angle(self):
        return atan2(self.imag, self.real)
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math.atan2(y,x): Angle between x-axis and the point (x,y)

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    @property
    def angle(self):
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    def __repr__(self):
        return 'ComplexRI({0}, {1})'.format(self.real,
                                            self.imag)
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```
class ComplexMA(object):

    def __init__(self, magnitude, angle):
        self.magnitude = magnitude
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    @property
    def real(self):
        return self.magnitude * cos(self.angle)
```

The Polar Representation

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class ComplexMA(object):

    def __init__(self, magnitude, angle):
        self.magnitude = magnitude
        self.angle = angle

    @property
    def real(self):
        return self.magnitude * cos(self.angle)

    @property
    def imag(self):
        return self.magnitude * sin(self.angle)
```

The Polar Representation

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class ComplexMA(object):

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        self.magnitude = magnitude
        self.angle = angle

    @property
    def real(self):
        return self.magnitude * cos(self.angle)

    @property
    def imag(self):
        return self.magnitude * sin(self.angle)

    def __repr__(self):
        return 'ComplexMA({0}, {1})'.format(self.magnitude,
                                            self.angle)
```

Using Complex Numbers

Either type of complex number can be passed as either argument to add_complex or mul_complex

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>>> add_complex(ComplexRI(1, 2), ComplexMA(2, pi/2))

ComplexRI(1.0000000000000002, 4.0)
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>>> add_complex(ComplexRI(1, 2), ComplexMA(2, pi/2))

ComplexRI(1.0000000000000002, 4.0)

>>> mul_complex(ComplexRI(0, 1), ComplexRI(0, 1))

ComplexMA(1.0, 3.141592653589793)
```

Special Methods

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Adding instances of user-defined classes use `__add__` method

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>>> ComplexRI(1, 2) + ComplexMA(2, 0)
ComplexRI(3.0, 2.0)
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Special Methods

Adding instances of user-defined classes use __add__ method

Demo

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ComplexMA(1.0, 3.141592653589793)
```

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

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