61A Lecture 18

Monday, October 13

Announcements

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String Representations

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- 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

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(Demo)

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Example:

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

Property Methods

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>>> f = Rational(3, 5)
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(Demo)

Example: Complex Numbers

Multiple Representations of Abstract Data

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Rectangular and polar representations for complex numbers

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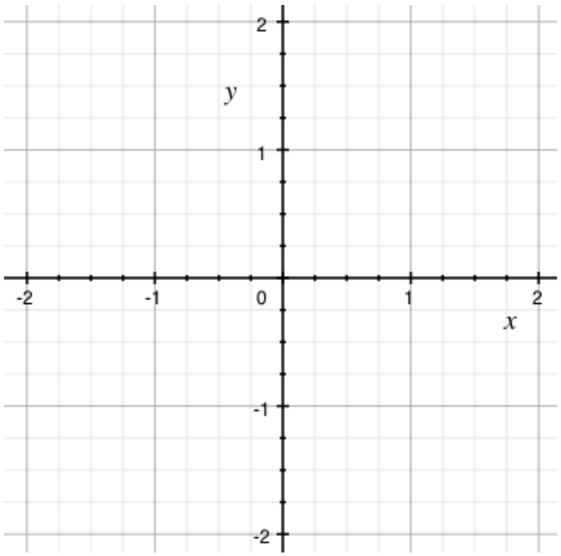
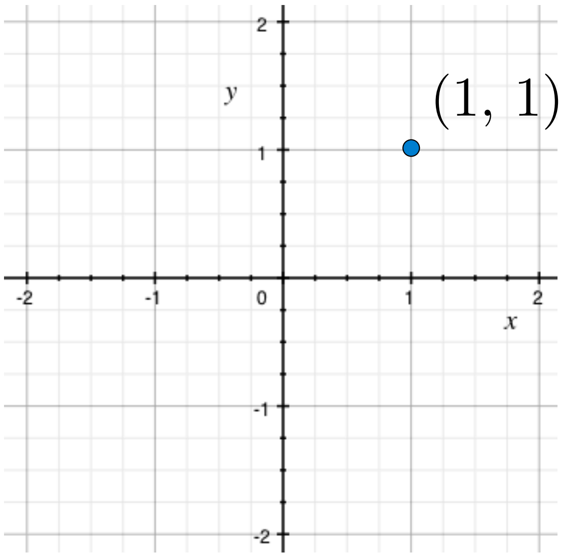
Rectangular and polar representations for complex numbers



Multiple Representations of Abstract Data

Rectangular and polar representations for complex numbers



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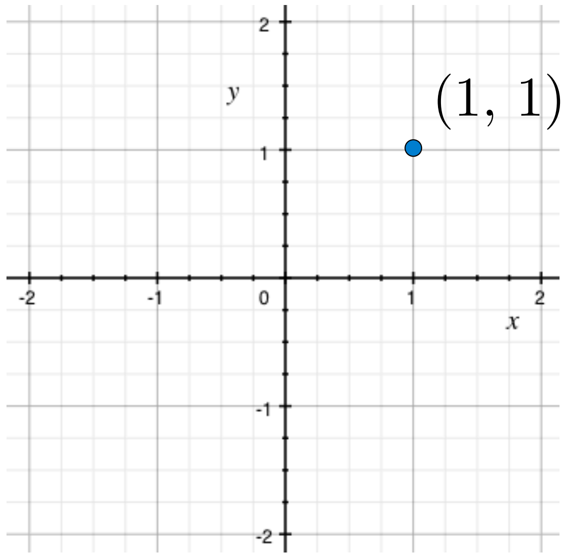

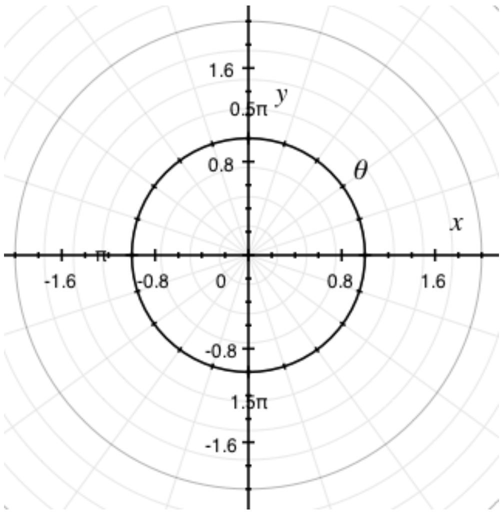

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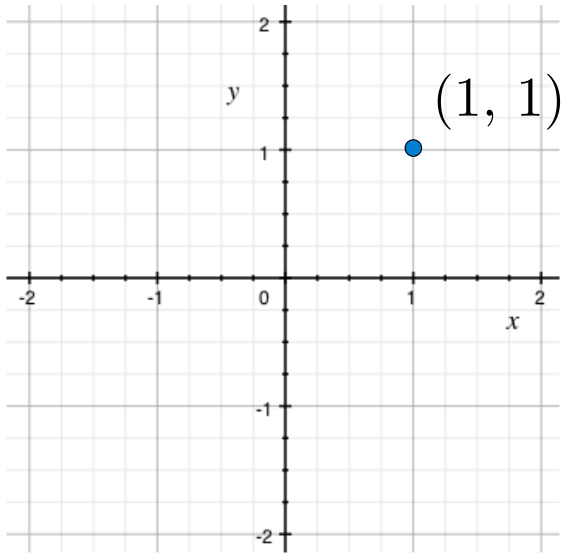

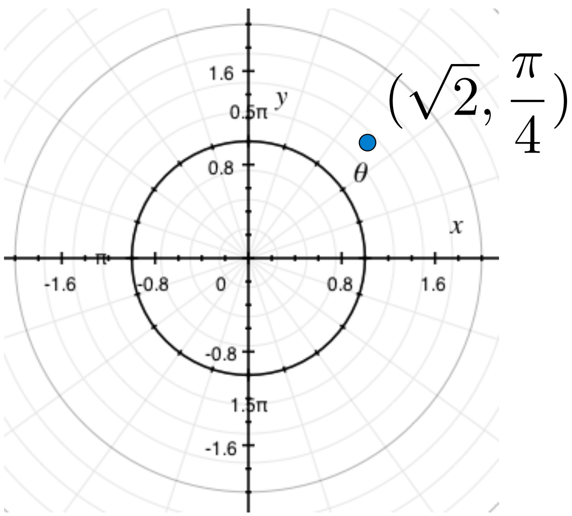

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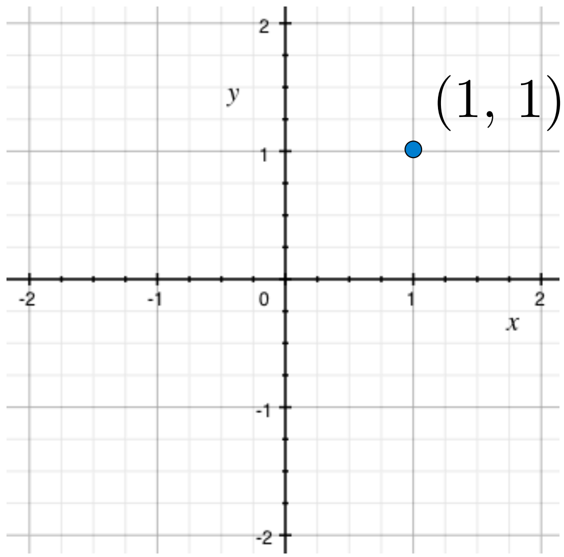

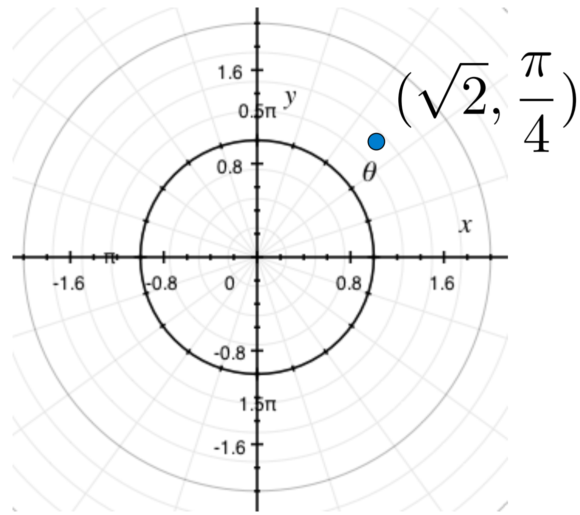

Most programs don't care about the representation

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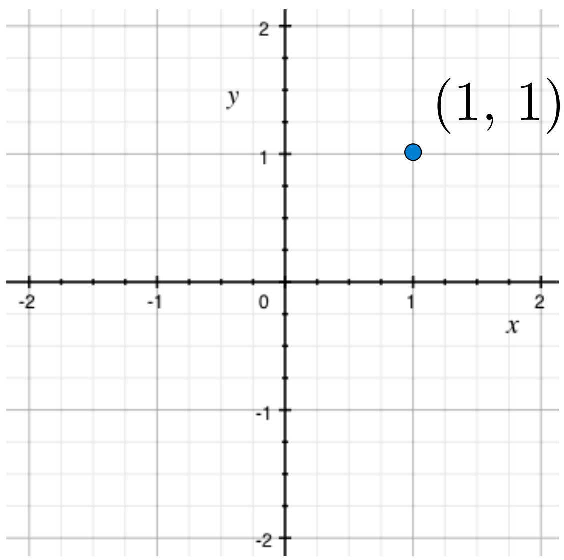

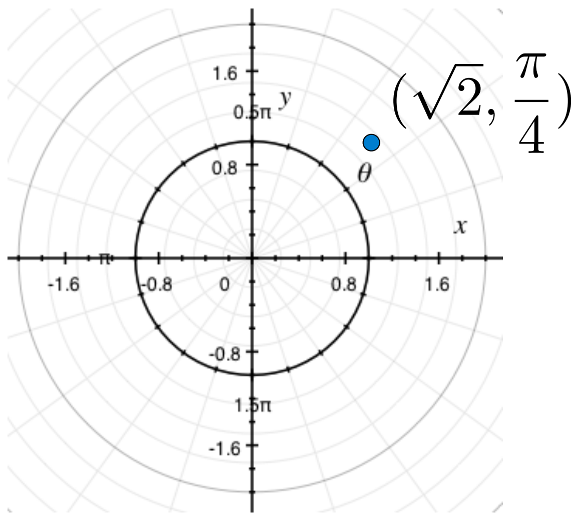

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Some arithmetic operations are easier using one representation than the other

Implementing Complex Arithmetic

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Assume that there are two different classes that both represent Complex numbers

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$$1 + \sqrt{-1}$$

Implementing Complex Arithmetic

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Number	Rectangular representation	Polar representation
$1+\sqrt{-1}$	**ComplexRI**(1, 1)	**ComplexMA**(sqrt(2), pi/4)

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class Complex:
    def add(self, other):
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class Complex:
    def add(self, other):
        return ComplexRI(self.real + other.real,
                         self.imag + other.imag)
    def mul(self, other):
        return ComplexMA(self.magnitude * other.magnitude,
                         self.angle + other.angle)
```

Complex Arithmetic Abstraction Barriers

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Parts of the program that...	Treat complex numbers as...	Using...

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Use complex numbers to perform computation		

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Add complex numbers		

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Parts of the program that...	Treat complex numbers as...	Using...
Use complex numbers to perform computation	whole data values	x.add(y), x.mul(y)
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Implementation of the Python object system

Implementing Complex Numbers

An Interface for Complex Numbers

An Interface for Complex Numbers

`All complex numbers should have real and imag components`

An Interface for Complex Numbers

All complex numbers should have `real` and `imag` components

All complex numbers should have a `magnitude` and `angle`

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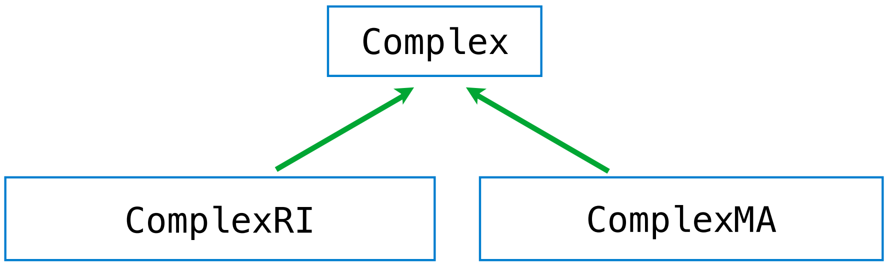

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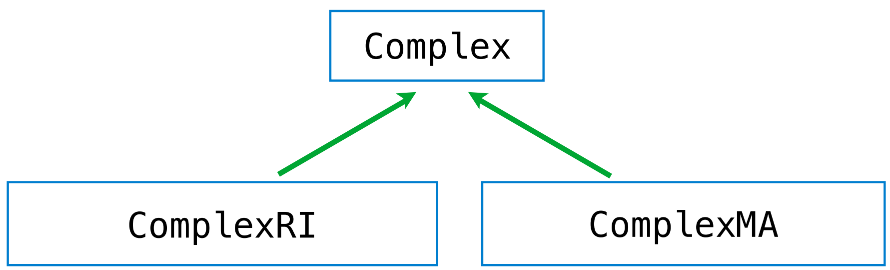

(Demo)

The Rectangular Representation

`The @property decorator allows zero-argument methods to be called without the standard call expression syntax, so that they appear to be simple attributes`

The Rectangular Representation

```
class ComplexRI:
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The `@property` decorator allows zero-argument methods to be called without the standard call expression syntax, so that they appear to be simple attributes

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class ComplexRI:

    def __init__(self, real, imag):
        self.real = real
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    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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math.atan2(y,x): Angle between x-axis and the point (x,y)

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    def __repr__(self):
        return 'ComplexRI({0}, {1})'.format(self.real, self.imag)
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The Polar Representation

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class ComplexMA:

    def __init__(self, magnitude, angle):
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class ComplexMA:

    def __init__(self, magnitude, angle):
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    @property
    def real(self):
        return self.magnitude * cos(self.angle)
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    @property
    def imag(self):
        return self.magnitude * sin(self.angle)
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    def __repr__(self):
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    def add(self, other):
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$1 + 4 \cdot \sqrt{-1}$

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-1