

DEFINING CLASSES

CSSE 120—Rose Hulman Institute of Technology

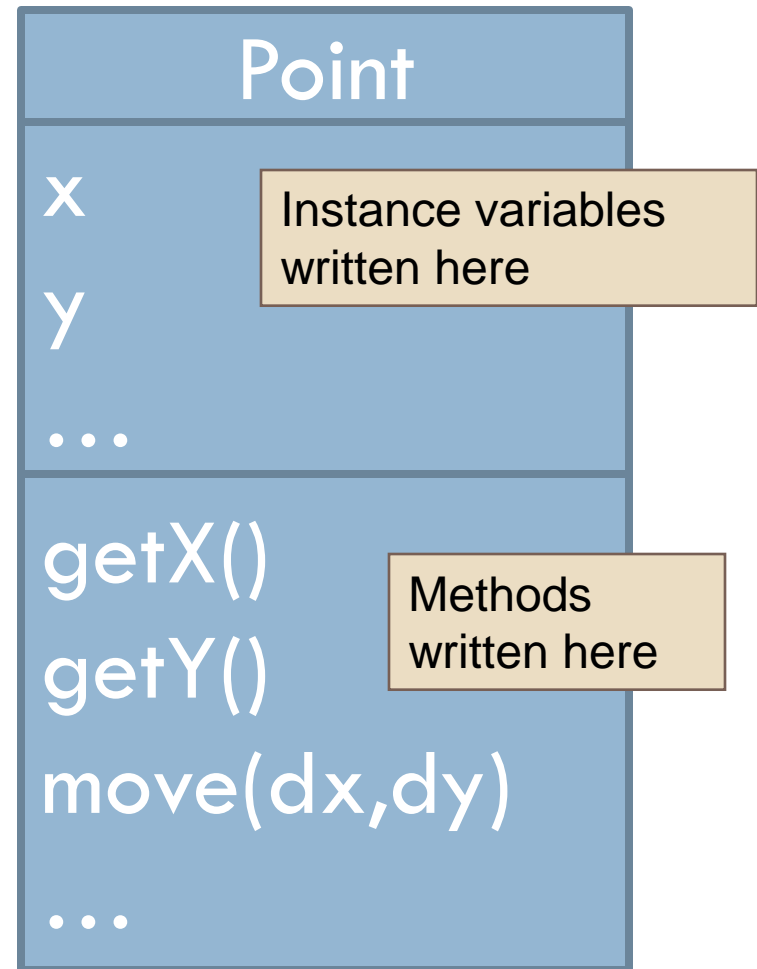
Review: Using Objects

```
WIDTH = 400
HEIGHT = 50
REPEAT_COUNT = 20
PAUSE_LENGTH = 0.25
win = GraphWin('Cubs Win!', WIDTH, HEIGHT)
p = Point(WIDTH/2, HEIGHT/2)
t = Text(p, 'Chicago Cubs--National League Central Champs!')
t.setStyle('bold')
t.draw(win)
nextColorIsRed = True
t.setFill('blue')
for i in range(REPEAT_COUNT):
    sleep(PAUSE_LENGTH)
    if nextColorIsRed:
        t.setFill('red')
    else:
        t.setFill('blue')
    nextColorIsRed = not nextColorIsRed
win.close()
```

Object Terminology

- Objects are *active data types*
 - ▣ They **know stuff**—
instance variables
 - ▣ They **can do stuff**—
methods
- Objects are *instances* of some *class*
- Objects created by calling *constructors*

- UML class diagram:



Key Concept!

- A class is like an "object factory"
 - ▣ Calling the constructor tells the classes to make a new object
 - ▣ Parameters to constructor are like "factory options", used to set instance variables
- Or think of class like a "rubber stamp"
 - ▣ Calling the constructor stamps out a new object shaped like the class
 - ▣ Parameters to constructor "fill in the blanks". That is, they are used to set instance variables.

Example

□ Consider:

```
p = Point(200, 100)
```

```
t = Text(p, 'Go Cubs!')
```

p

Point

x 200

y 100

fill 'black'

outline 'black'

getX() ...

getY() ...

...

t

Text

anchor →

text 'Go Cubs'

getAnchor() ...

getText() ...

setText(text)

setStyle(style)

...

Point

x 200

y 100

fill 'black'

outline 'black'

getX() ...

getY() ...

...

This is a *clone* of p

Creating Custom Objects: Defining Your Own Classes

- Custom objects:
 - ▣ Hide complexity
 - ▣ Provide another way to break problems into pieces
 - ▣ Make it easier to pass information around
- Example: Cards, Decks, and Hands

- ▣ Recall from BlackJack:

```
suits = ['Clubs', 'Diamonds', 'Hearts', 'Spades']  
cardNames = ['Ace', 'Deuce', '3', '4', '5', '6', '7',  
             '8', '9', '10', 'Jack', 'Queen', 'King']
```

Code to Define a Class

Declares a class
named Card

```
class Card:
```

```
"""This class represents a card from a standard deck."""
```

docstring
describes class,
used by help()
function and by
Eclipse help

Code to Define a Class

Special name, `__init__`
declares a **constructor**

```
class Card:
```

```
    """This class represents a card fr
```

```
    def __init__(self, card, suit):
```

```
        self.cardName = card
```

```
        self.suitName = suit
```

Special **self parameter** `"""`
is the first formal
parameter of each
method in a class.
self always refers to
the current object

Create instance variables just
by assigning to them

c

Card

cardName _____

suitName _____

```
def __init__(self, card, suit):
```

```
    self.cardName = card
```

```
    self.suitName = suit
```

A sample constructor call:

c = Card('Ace', 'Hearts')

'Ace'

'Hearts'

Code to Define a Class

```
class Card:
```

```
    """This class represents a card from a standard deck."""
```

```
    def __init__(self, card, suit):
```

```
        self.cardName = card
```

```
        self.suitName = suit
```

self parameter again, no other formal parameters

docstring for method

```
    def getValue(self):
```

```
        """Returns the value of this card in BlackJack.
```

```
        Aces always count as one, so hands need to adjust to count aces as 11."""
```

```
        pos = cardNames.index(self.cardName)
```

```
        if pos < 10:
```

```
            return pos + 1
```

```
        return 10
```

use `self.<varName>` to read instance variable

A sample method call:

c.getValue()

Card...

Code to Define a Class

```
class Card:
```

```
    """This class represents a card from a standard deck."""
```

```
    def __init__(self, card, suit):
```

```
        self.cardName = card
```

```
        self.suitName = suit
```

```
    def getValue(self):
```

```
        """Returns the value of this card in BlackJack.
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        Aces always count as one, so hands need to adjust  
        to count aces as 11."""
```

```
        pos = cardNames.index(self.cardName)
```

```
        if pos < 10:
```

```
            return pos + 1
```

```
        return 10
```

```
    def __str__(self):
```


```
        return self.cardName + " of " + self.suitName
```

Sample uses of `__str__` method:

```
print c
```

```
msg = "Card is " + str(c)
```

Special `__str__` method returns
a string representation of an object



Stepping Through Some Code

Sample use:

```
card = Card('7', 'Clubs')
print card.getValue()
print card
```

```
class Card:
```

```
    """This class represents a card
```

```
    def __init__(self, card, suit):
```

```
        self.cardName = card
```

```
        self.suitName = suit
```

```
    def getValue(self):
```

```
        """Returns the value of this card in BlackJack.
```

```
        Aces always count as one, so hands need to adjust  
to count aces as 11."""
```

```
        pos = cardNames.index(self.cardName)
```

```
        if pos < 10:
```

```
            return pos + 1
```

```
        return 10
```

```
    def __str__(self):
```

```
        return self.cardName + " of " + self.suitName
```

Key Ideas

□ *Constructor:*

- Defined with special name `__init__`
- Called like `ClassName()`

□ *Instance variables:*

- Created when we assign to them
- Live as long as the object lives

□ *self* formal parameters:

- Implicitly get the value *before the dot* in the call
- Allows method of an object to "talk about itself"

Another Example:

Lists of Objects, Lists in Object

```
class CardCollection:
```

```
    """This class represents a collection of cards, either a  
    single hand or the whole deck."""
```

```
    def __init__(self, newDeck = False):
```

```
        """Creates a new collect  
        it's empty, but if newDe  
        collection is a full sta
```

```
        self.name = None
```

```
        self.cardList = []
```

```
        self.hideFirst = True
```

```
        if newDeck:
```

```
            # Create an entire deck of cards
```

```
            for s in suits:
```

```
                for c in cardNames:
```

```
                    self.insert(Card(c, s))
```

Optional formal parameter, can construct a CardCollection three ways:

```
deck = CardCollection(True)
```

```
hand = CardCollection(False)
```

```
hand = CardCollection()
```

Instance variable
containing a list

...

Self call, constructor calls another method of the CardCollection class

Another Example (continued): Lists of Objects, Lists in Object

```
class CardCollection:
```

```
    """..."""
```

```
    def __init__(self, newDeck = False):
```

```
        """..."""
```

```
        self.name = None
```

```
        self.cardList = []
```

```
        self.hideFirst = True
```

```
        if newDeck:
```

```
            # Create an entire deck of cards
```

```
            for s in suits:
```

```
                for c in cardNames:
```

```
                    self.insert(Card(c, s))
```

```
    def insert(self, card)
```

```
        """Adds the given card to this collection."""
```

```
        self.cardList.append(card)
```

insert method uses append()
method to mutate the list instance
variable

We can put objects into lists.

Why not just use a list of cards?

```
class CardCollection:
```

```
...
```

```
def getValue(self):
```

```
    """Returns the best score for this collection  
    in the game of BlackJack."""
```

```
    score = 0
```

```
    hasAce = False
```

```
    for card in self.cardList:
```

```
        val = card.getValue()
```

```
        score += val
```

```
        if val == 1:
```

```
            hasAce = True
```

```
    if score <= winningScore - 10 and hasAce:
```


```
        score += 10
```

```
    return score
```

Iterating over the list



Calling methods on
the objects stored in
the list



Encapsulation

- Insulating the rest of a program from some details by "hiding" them inside some structure
 - ▣ Top-down design encapsulates **operations** inside functions
 - ▣ Object-oriented design encapsulates **data and operations** inside classes
- Encapsulation is a form of abstraction—ignoring irrelevant details

Check It Out

- Use Eclipse *SVN Repository Exploring* perspective
 - Go to your repository:
<http://svn.cs.rose-hulman.edu/repos/csse120-fall07-username>
 - Check-out the **BallSim** project
- Switch back to the *PyDev* perspective
- The **blackjackWithClasses** module is there for you to review as an example of defining classes

That's the Way the Ball Bounces!

- We're going to begin working with defining classes by creating a simulation of an ideal gas
- Like simulating billiard balls on a frictionless table
- We hope this will be a straightforward and enjoyable assignment
- Begin by opening the instructions from ANGEL:
 - ▣ Lessons → Homework → Homework 14
- Try to get to step 4g in class.
GET HELP IF YOU GET STUCK!