CSc 110, Spring 2017

Lecture 37: Critters

Adapted from slides by Marty Stepp and Stuart Reges

Calling overridden methods

- Subclasses can call overridden methods with `super`

  `super(`**ClassName**`, self).`**method**`(`**parameters**`)`

  - Example:

```
class LegalSecretary(Secretary):
    def get_salary(self):
        base_salary = super(LegalSecretary,self).get_salary()
        return base_salary + 5000.0
    ...
```

Name the superclass of `LegalSecretary` _____

What method did `LegalSecretary` override? _____

What code creates an *instance* of the class `LegalSecretary`? _____

Inheritance and constructors

- Imagine that we want to give employees more vacation days the longer they've been with the company.
  - For each year worked, we'll award 2 additional vacation days.
  - When an Employee object is constructed, we'll pass in the number of years the person has been with the company.
  - This will require us to modify our `Employee` class and add some new state and behavior.
  - Exercise: Make necessary modifications to the `Employee` class.

Modified `Employee` class

```
class Employee:
    def __init__(self, initial_years):
        self.__years = initial_years

    def get_hours(self):
        return 40

    def get_salary(self):
        return 40000.0

    def get_vacation_days(self):
        return 10 + 2 * self.__years

    def get_vacation_form(self):
        return "yellow"
```

Problem with constructors

- Now that we've added the constructor to the `Employee` class, an error is produced:

```
TypeError: __init__() missing 1 required positional
 argument: 'initial_years'
```

  - Short explanation: Once we write an `__init__(self, p1, … pn)` that requires parameters in the superclass, we must now write initialization methods for our employee subclasses as well.

  - Exception: If the default behavior of the superclass is acceptable for all subclasses, you simply modify the class constructor expression.

Modified `Marketer` class

```
# A class to represent marketers.
class Marketer(Employee):
    def __init__(self, years):
        super(Marketer, self).__init__(years)

    def advertise(self):
        print("Act now while supplies last!")

    def get_salary():
        return super(Marketer, self).get_salary() + 10000.0
```

- Exercise: Modify the `Secretary` subclass.
  - Secretaries' years of employment are not tracked.
  - They do not earn extra vacation for years worked.

Modified `Secretary` class

```
# A class to represent secretaries.
class Secretary(Employee):
    def __init__(self):
        super(Secretary, self).__init__(0)

    def take_dictation(self, text):
        print("Taking dictation of text: " + text)
```

- Since `Secretary` doesn't require any parameters to its constructor, `LegalSecretary` does not require a constructor.
  - Its default constructor calls the `Secretary` constructor.

Inheritance and attributes

- Try to give lawyers $5000 for each year at the company:

```
class Lawyer(Employee):
    ...
    def get_salary(self):
        return super(Lawyer, self).get_salary() + 5000 *
self.__years
    ...
```

- Does not work; the error is the following:

```
AttributeError: 'Lawyer' object has no attribute
  '_Lawyer__years'                                    ^
```

- Private attributes cannot be directly accessed from subclasses.
  - One reason: So that subclassing can't break encapsulation.
  - How can we get around this limitation?

Improved `Employee` code

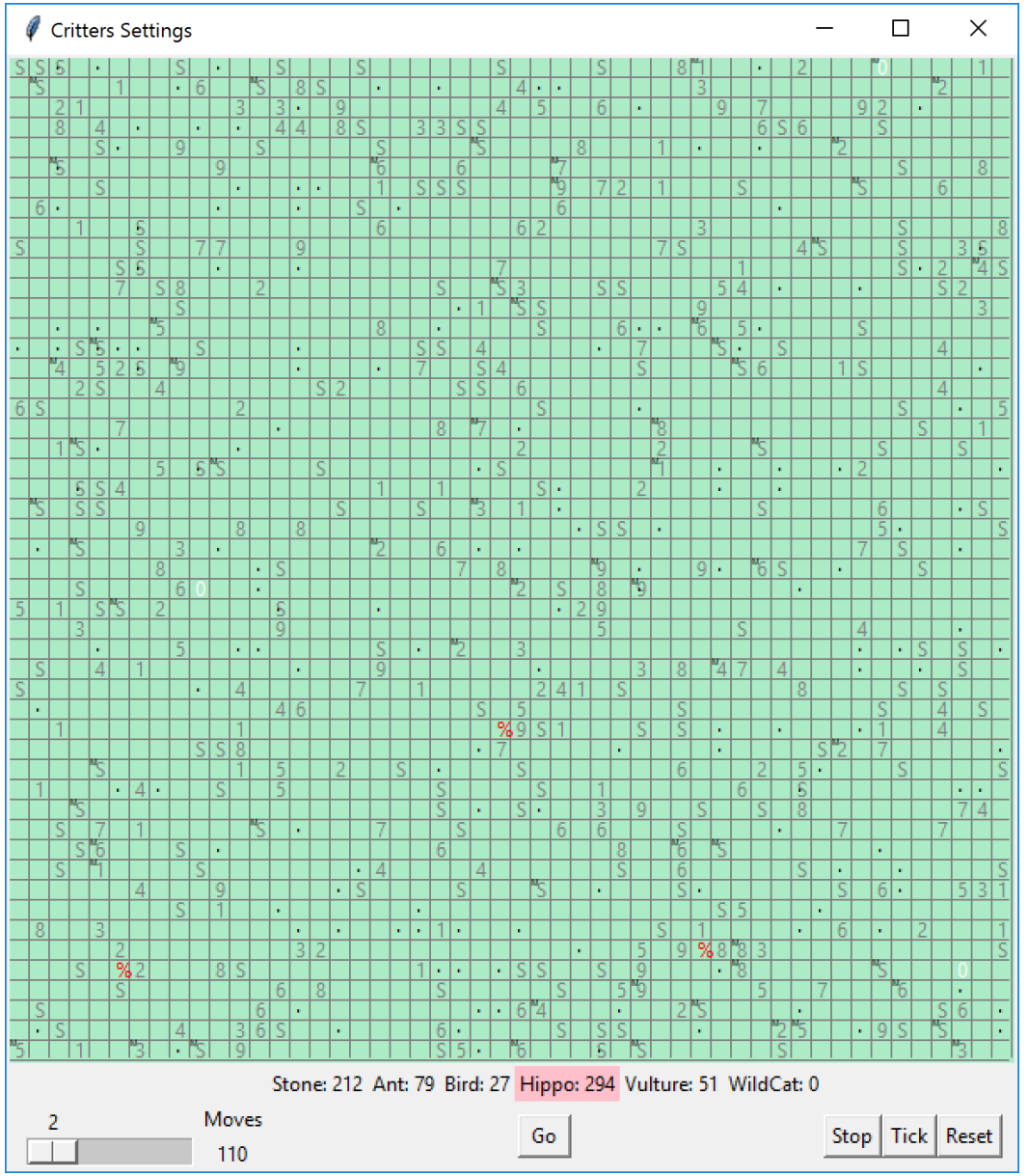
Add an accessor for any attribute needed by the subclass.

```
class Employee:

    def __init__(self, initial_years):
        self.__years = initial_years

    def get_years(self):
        return self.__years
    ...

class Lawyer(Employee):
    def __init__(self, years):
        super(Lawyer, self).__init__(years)

    def get_salary(self):
        return super(Lawyer, self).get_salary() + 5000 * self.get_years()
    ...
```

CSc 110 Critters

- `Ant`
- `Bird`
- `Hippo`
- `Vulture`
- `WildCat` (creative)

- behavior:
  - `eat` eating food
  - `fight` animal fighting
  - `get_color` color to display
  - `get_move` movement
  - `__str__` letter to display



Inherit from the `Critter` class

- Syntax: `class` **name`(Critter)`**`:`

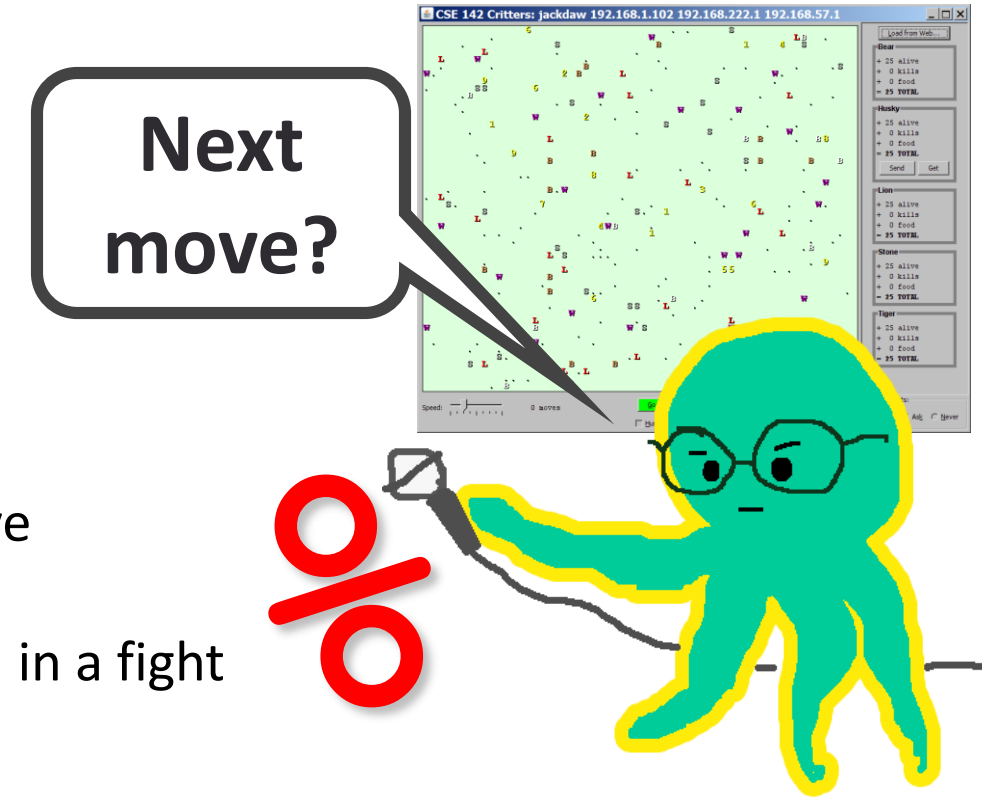
```
class NewAnimal(Critter):
    def eat()
        # returns True or False
    def fight(opponent)
        # ROAR, POUNCE, SCRATCH
    def get_color()
        # returns a string for the color, e.g., "blue"
    def get_move()
        # returns NORTH, SOUTH, EAST, WEST, CENTER
    def __str__()
```

How the simulator works

- "Go" → loop:
  - move each animal (`get_move`)
  - if they collide, `fight`
  - if they find food, `eat`

- The simulator keeps score based on:
  - How many animals of that kind are still alive
  - How much food they have eaten
  - How many other animals they have beaten in a fight

- Simulator is in control!
  - `get_move` is <u>one move</u> at a time
    - (*no loops*)
  - Keep <u>state</u> (attributes)
    - to remember for future moves



Development Strategy

- Simulator helps you debug
  - smaller width/height
  - fewer animals
  - **"Tick"** instead of "Go"

- Write your own main
  - call your animal's methods and print what they return

The `Critter` class

```
class Critter():
    def eat(self):
        return False

    def fight(self, opponent):
        return ATTACK_FORFEIT

    def get_color(self):
        return "grey"

    def get_move(self):
        return DIRECTION_CENTER

    def __str__(self):
        return "?"
```

The `Critter` class constants

```
# Constants for attacks, directions
ATTACK_POUNCE    = 0
ATTACK_ROAR      = 1
ATTACK_SCRATCH   = 2
ATTACK_FORFEIT   = 3
DIRECTION_NORTH  = 0
DIRECTION_SOUTH  = 1
DIRECTION_EAST   = 2
DIRECTION_WEST   = 3
DIRECTION_CENTER = 4
```

Critter exercise: `Cougar`

- Write a critter class `Cougar`:

Method	Behavior
`__init__`	
`eat`	Always eats.
`fight`	Always pounces.
`get_color`	Blue if the `Cougar` has never fought; red if he has.
`get_move`	Walks west until he finds food; then walks east until he finds food; then goes west and repeats.
`__str__`	`"C"`

Critter exercise: `Cougar`

- We need to know two things about its state:
  - If it has ever fought
  - How much food it has eaten in order to return the correct direction (West/Eat/East/Eat/West/Eat/East, and so on)

Method	Behavior
`__init__`	
`eat`	Always eats.
`fight`	Always pounces.
`get_color`	Blue if the `Cougar` has never fought; red if he has.
`get_move`	Walks west until he finds food; then walks east until he finds food; then goes west and repeats.
`__str__`	`"C"`

The Cougar class

```
from Critter import *

class Cougar(Critter):
    # returns a Cougar
    def __init__(self):
        self.fought = False
        self.eaten = 0

    # returns "C" as a representation of the cougar
    def __str__(self):
        return "C"

    # returns that the critter does want to eat
    def eat(self):
        self.eaten += 1
        return True
```

The Cougar class- cont.

```
# returns the pounce attack
   def fight(self, opponent):
       self.fought = True
       return ATTACK_POUNCE

   # returns west until the critter eats, returns east until it
   # eats again and then repeats
   def get_move(self):
       if(self.eaten % 2 == 0):
           return DIRECTION_WEST
       else:
           return DIRECTION_EAST

   # returns blue if the critter has never fought and red if it has
    def get_color(self):
       if(not self.fought):
           return "blue"
       else:
           return "red"
```

Ideas for state

- You must not only have the right state, but update that state properly when relevant actions occur.

- Counting is helpful:
  - How many total moves has this animal made?
  - How many times has it eaten? Fought?

- Remembering recent actions in attributes is helpful:
  - Which direction did the animal move last?
    - How many times has it moved that way?
  - Did the animal eat the last time it was asked?
  - How many steps has the animal taken since last eating?
  - How many fights has the animal been in since last eating?

Critter exercise: `Anteater`

- Write a critter class `Anteater`:

Method	Behavior
`__init__`	
`eat`	Eats 3 pieces of food and then stops
`fight`	randomly chooses between pouncing and roaring
`get_color`	pink if hungry and red if full
`get_move`	walks up two and then down two
`__str__`	`"a"` if hungry `"A"` otherwise