This assignment focuses on classes and objects. Turn in ant.py, bird.py, hippo.py, vulture.py, and wildcat.py. Download supporting files on the course web site. Run critters.py to start the simulation.

Program Behavior:
You are provided with a client program class that implements a graphical simulation of a 2D world of animals. You will write classes that define the behavior of those animals. Animals move and behave in different ways. Your classes will define the unique behaviors for each animal.

The critter world is divided into cells with integer coordinates. The world is 60 cells wide and 50 cells tall. The upper-left cell has coordinates (0, 0); x increases to the right and y increases downward.

Movement
On each round of the simulation, the simulator asks each critter object which direction it wants to move. Each round a critter can move one square north, south, east, west, or stay at its current location ("center"). The world has a finite size, but it wraps around in all four directions (for example, moving east from the right edge brings you back to the left edge).

This program will be confusing at first, because you do not write its main function; your code is not in control of the overall execution. Instead, your objects are part of a larger system. You might want your critters make several moves at once using a loop, but you can't. The only way a critter moves is to wait for the simulator to ask it for a single move and return that move. This experience can be frustrating, but it is a good introduction to object-oriented programming.

Fighting/Mating
As the simulation runs, animals may collide by moving onto the same location. When two animals collide, if they are from different species, they fight. The winning animal survives and the losing animal is removed from the game. Each animal chooses one of ATTACK_ROAR, ATTACK_POUNCE, or ATTACK_SCRATCH. Each attack is strong against one other (e.g. roar beats scratch) and weak against another (roar loses to pounce). The following table summarizes the choices and which animal will win in each case. To remember which beats which, notice that the starting letters of "Roar, Pounce, Scratch" match those of "Rock, Paper, Scissors." If the animals make the same choice, the winner is chosen at random.

<table>
<thead>
<tr>
<th>Critter #1</th>
<th>ATTACK_ROAR</th>
<th>ATTACK_POUNCE</th>
<th>ATTACK_SCRATCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATTACK_ROAR</td>
<td>random winner</td>
<td>#2 wins</td>
<td>#1 wins</td>
</tr>
<tr>
<td>ATTACK_POUNCE</td>
<td>#1 wins</td>
<td>random winner</td>
<td>#2 wins</td>
</tr>
<tr>
<td>ATTACK_SCRATCH</td>
<td>#2 wins</td>
<td>#1 wins</td>
<td>random winner</td>
</tr>
</tbody>
</table>

If two animals of the same species collide, they "mate" to produce a baby. Animals are vulnerable to attack while mating: any other animal that collides with them will defeat them. An animal can mate only once during its lifetime.

Eating
The simulation world also contains food (represented by the period character, ".") for the animals to eat. There are pieces of food on the world initially, and new food slowly grows into the world over time. As an animal moves, it may encounter food, in which case the simulator will ask your animal whether it wants to eat it. Different kinds of animals have different eating behavior; some always eat, and others only eat under certain conditions.

Every time one class of animals eats a few pieces of food, that animal will be put to "sleep" by the simulator for a small amount of time. While asleep, animals cannot move, and if they enter a fight with another animal, they will always lose.

Scoring
The simulator keeps a score for each class of animal, shown on the right side of the screen. A class's score is based on how many animals of that class are alive, how much food they have eaten, and how many other animals they have killed.
Provided Files:
Each class you write will extend a superclass named **Critter**. This is an example of inheritance, as discussed lecture 34. Inheritance makes it easier for our code to talk to your critter classes, and it helps us be sure that all your animal classes will implement all the methods we need. Your class headers should indicate the inheritance by writing `(Critter)`, like the following:

```python
class Ant(Critter): ...
```

The **Critter** class contains the following methods, some/all of which you must write in each of your classes:

- **def eat()**
  When your animal encounters food, our code calls this on it to ask whether it wants to eat (true) or not (false).

- **def fight(opponent)**
  When two animals move onto the same square of the grid, they fight. When they collide, our code calls this on each animal to ask it what kind of attack it wants to use in a fight with the given opponent.

- **def get_color()**
  Every time the board updates, our code calls this on your animal to ask it what color it wants to be drawn with.

- **def get_move()**
  Every time the board updates, our code calls this on your animal to ask it which way it wants to move.

- **def __str__()**
  Every time the board updates, our code calls this on your animal to ask what letter it should be drawn as.

Just by writing `(Critter)` as shown above, you receive a **default version** of these methods. The default behavior is to never eat, to always forfeit fights, to use the color gray, to always stand still (a move of CENTER), and a `__str__` of "?". If you don't want this default, rewrite (override) the methods in your class with your own behavior.

For example, below is a critter class **Stone**. A **Stone** is displayed with the letter `S`, is gray in color, never moves or eats, and always roars in a fight. Your classes will look like this class, except with fields, a constructor, and more sophisticated code. The **Stone** does not need an `eat` or `get_move` method; it uses the default behavior for those operations.

```python
class Stone(Critter):
    def fight(opponent):
        return ATTACK_ROAR

    def get_color(self):
        return "gray"

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

**NOTE:** You are not necessarily required to write `(Critter)` on every single animal class you write. If you find that two animal classes are very similar to each other, you should have one extend the other to reduce redundancy.

**Running the Simulator:**
When you press the Go button, it begins a series of turns. On each turn, the simulator does the following for each animal:

- move the animal once (calling its `get_move` method), in random order
- if the animal has moved onto an occupied square, fight! (call both animals' `fight` methods) or mate
- if the animal has moved onto food, ask it if it wants to eat (call the animal's `eat` method)

After moving all animals, the simulator redraws the screen, asking each animal for its `__str__` and `get_color` values. It can be difficult to test and debug with many animals. We suggest adjusting the initial settings to use a smaller world and fewer animals.
Critter Classes:
The following are the five animal classes to implement. Each has one constructor that accepts exactly the parameter(s) in the table. For random moves, each choice must be equally likely; use `random` for this.

1. Ant

<table>
<thead>
<tr>
<th>constructor</th>
<th><code>__init__(walk_south)</code></th>
</tr>
</thead>
<tbody>
<tr>
<td>color</td>
<td>red</td>
</tr>
<tr>
<td>eating behavior</td>
<td>always returns True</td>
</tr>
<tr>
<td>fighting behavior</td>
<td>always scratch</td>
</tr>
<tr>
<td>movement</td>
<td>if the Ant was constructed with a <code>walk_south</code> value of <code>True</code>, then alternates between south and east in a zigzag (S, E, S, E, ...); otherwise, if the Ant was constructed with a <code>walk_south</code> value of <code>False</code>, then alternates between north and east in a zigzag (N, E, N, E, ...)</td>
</tr>
</tbody>
</table>

| `__str__` | "%" (percent) |

2. Bird

<table>
<thead>
<tr>
<th>constructor</th>
<th><code>__init__()</code></th>
</tr>
</thead>
<tbody>
<tr>
<td>color</td>
<td>blue</td>
</tr>
<tr>
<td>eating behavior</td>
<td>never eats (always returns False)</td>
</tr>
<tr>
<td>fighting behavior</td>
<td>roars if the opponent looks like an Ant (&quot;%&quot;); otherwise pounces</td>
</tr>
<tr>
<td>movement</td>
<td>a clockwise square: first goes north 3 times, then east 3 times, then south 3 times, then west 3 times, then repeats</td>
</tr>
</tbody>
</table>

| `__str__` | "^" (caret) if the bird's last move was north or it has not moved; ">" (greater-than) if the bird's last move was east; "\" (uppercase letter v) if the bird's last move was south; "<" (less-than) if the bird's last move was west |

3. Hippo

<table>
<thead>
<tr>
<th>constructor</th>
<th><code>__init__(hunger)</code></th>
</tr>
</thead>
<tbody>
<tr>
<td>color</td>
<td>gray if the hippo is still hungry (if <code>eat</code> would return <code>True</code>); otherwise white</td>
</tr>
<tr>
<td>eating behavior</td>
<td>returns <code>True</code> the first <code>hunger</code> times it is called, and <code>False</code> after that</td>
</tr>
<tr>
<td>fighting behavior</td>
<td>if this Hippo is hungry (if <code>eat</code> would return <code>True</code>), then scratches; else pounces</td>
</tr>
<tr>
<td>movement</td>
<td>moves 5 steps in a random direction (north, south, east, or west), then chooses a new random direction and repeats</td>
</tr>
</tbody>
</table>

| `__str__` | the number of pieces of food this Hippo still wants to eat, as a String |

The Hippo constructor accepts a parameter for the maximum number of food that Hippo will eat in its lifetime (the number of times it will return True from a call to `eat`). For example, a Hippo constructed with a parameter value of 8 will return True the first 8 times `eat` is called and False after that. Assume that the value passed is non-negative.

The `__str__` method for a Hippo returns the number of times that a call to `eat` would return True for that Hippo. For example, if a Hippo(4) is constructed, initially its `__str__` returns "4". After `eat` has been called on it once, calls to `__str__` return "3", and so on, until the Hippo is no longer hungry, after which all calls to `__str__` return "0".

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4. Vulture

**constructor**  
__init__()

**color**  
black

**eating behavior**  
Returns True if vulture is hungry. A vulture is initially hungry, and he remains hungry until he eats once. After eating once he will become non-hungry until he gets into a fight. After one or more fights, he will be hungry again. (see below)

**fighting behavior**  
roars if the opponent looks like an Ant ("%"); otherwise pounces

**movement**  
a clockwise square: first goes north 3 times, then east 3 times, then south 3 times, then west 3 times, then repeats

**toString**  
"^" (caret) if the vulture's last move was north or has not moved;  
">" (greater-than) if the vulture's last move was east;  
"V" (uppercase letter v) if the vulture's last move was south;  
"<" (less-than) if the vulture's last move was west

A Vulture is a specific sub-category of bird with some changes. Think of the Vulture as having a "hunger" that is enabled when he is first born and also by fighting. Initially the Vulture is hungry (so eat would return True from a single call). Once the Vulture eats a single piece of food, he becomes non-hungry (so future calls to eat would return False). But if the Vulture gets into a fight or a series of fights (if fight is called on it one or more times), it becomes hungry again. When a Vulture is hungry, the next call to eat should return True. Eating once causes the Vulture to become "full" again so that future calls to eat will return False, until the Vulture's next fight or series of fights.

5. Wild Cat

**constructor**  
__init__()  
(must not accept any parameters)

**all behavior**  
you decide (see below)

You will decide the behavior of your WildCat class. Part of your grade will be based upon writing creative and non-trivial WildCat behavior. The following are some guidelines and hints about how to write an interesting WildCat.

Your WildCat's fighting behavior may want to utilize the opponent parameter to the fight method, which tells you what kind of critter you are fighting against (such as "%" if you are fighting against a Ant). Your WildCat can return any text you like from __str__ and any color from get_color. Each critter's get_color and __str__ are called on each simulation round, so you can have a WildCat that displays differently over time. The __str__ text is also passed to other animals when they fight you; you may want to try to fool other animals.

Unlike on most assignments, your WildCat can use any advanced material you happen to know in Python. If your WildCat uses additional classes you have written, contact your TA or instructor to make sure it will be compatible with our system.

Each critter class has some additional methods that it receives by inheritance from Critter. Your WildCat may want to use these methods to guide its behavior. None of the methods below are needed for Ant, Bird, Hippo, or Vulture.

- def getX(), def getY()  
  Returns your critter's current x and y coordinates. For example, to check whether your critter's x-coordinate is greater than 10, you would write code such as:  
  ```python  
  if (getX() > 10):  
  ```

- def get width(), def get height()  
  Returns the width and height of the simulation grid.

- Def get_neighbor(direction)  
  Returns a String representing what is next to your critter in the given direction. " " means an empty square. For example, to check if your neighbor to the west is a "Q", you could write this in your get_move method:  
  ```python  
  if (get_neighbor(WEST) == "Q"):
  ```

- public void win(), public void sleep(), public void mate(), public void reset(), public void lose(), public void wakeup(), public void mate_end()  
  The simulator calls these methods on your critter to notify you when you have won/lost a fight, been put to sleep/wake up, start/end mating, or when the game world has reset, respectively.
Development Strategy:
The simulator runs even if you haven't completed all the critters. The classes increase in difficulty from Ant to Bird to Hippo to Vulture. We suggest doing Ant first. Look at stone.py and the lecture/section examples to see the general structure.

It will be impossible to implement each behavior if you don't have the right state in your object. As you start writing each class, spend some time thinking about what state will be needed to achieve the desired behavior.

One thing that students in the past have found particularly difficult to understand is the various constructors for each type of animal. Some of the constructors accept parameters that guide the behavior of later methods of the animal. It is your job to store data from these parameters into fields of the animal as appropriate, so that it will "remember" the proper information and will be able to use it later when the animal's other methods are called by the simulator.

Test your code incrementally. A critter class will run even if you have not written all of the methods (the unwritten ones will use default behavior). So add one method, run the simulator to see that it works, then add another.

Critter Tournament:
On the last day of class, we will host a Critter tournament. In each battle, two students' WildCat classes will be placed into the simulator along with the other standard animals. The student with the higher score in the right sidebar advances.

A "battle" is defined as the following: We run Critters with a standard 60x50 world, using 25 of each kind of animal. The animals present are Ants, Birds, Hippos, Vultures, Stones, and two students' WildCats. We start the simulator and let it run until either one student's WildCats are completely eliminated or until roughly 1000 moves have passed. At this point whichever student's WildCat species has the more points wins the battle.

Think of the tournament like one of the major pro sports. We will run a "regular season" in which every student's WildCat species will play many battles against randomly chosen opponent WildCat classes. We run a season of many games (at least 64 for each student), then we grab the top 16 students that have the best win/loss records. They advance to the "playoffs", which will take place live in lecture on the last day of class.

The playoffs consists of a 16-WildCat bracket similar to part of an NCAA basketball tournament bracket. WildCat #1 battles #16, #2 battles #15, and so on. Winners advance and losers are eliminated. Eventually one WildCat is the champion.

No grade points will be based on tournament performance. For example, a WildCat that sits completely still might fare well in the tournament, but it will not receive full grade points because it is too trivial.

Style Guidelines:
Since this assignment is largely about classes and objects, much of the style grading will be about how well you follow proper object-oriented programming style. You should encapsulate the data inside your objects, and you should not declare unnecessary data fields to store information that isn't vital to the state of the object. Style points will also be awarded for expressing each critter's behavior elegantly.

Another aspect of the style of this program is inheritance. Your critter classes should properly extend the Critter superclass as described. Inheritance can also be used to remove redundancy between classes that are similar, and you should make use of this concept in your classes as appropriate. In other words, if two of your critter classes A and B are very much alike, you should have B extend A rather than having both simply extend Critter.

Some of the style points for this assignment will be awarded on the basis of how much energy and creativity you put into defining an interesting WildCat class. These points allow us to reward the students who spend time writing an interesting critter definition. Your WildCat's behavior should not be trivial or closely match that of an existing animal shown in class.

Follow past style guidelines about spacing, identifiers, and localizing variables. Place comments at the beginning of each class documenting that critter's behavior, and on any complex code. Your critters should not produce any console output.