CS 3005: Programming in C++

Predator/Prey Simulation Part 1

This assignment is the first of two assignments in which you will construct a simulation program to observe the effects of balance in the predator/prey food chain. We are concerned with two types of **Critters**: **Lions** (which are predators) and **Zebras** (which are prey).

**Assignment**

Create the classes **Critter**, **Lion** and **Zebra**, following the programming requirements listed below. The classes must pass all of the unit tests available in CodeGrinder. [UML Class Diagram]

**Critter** is a base class used to represent the common data members and methods shared by predators and prey. It also has some abstract methods that must be overridden by its child classes.

**Zebras** mainly move around and reproduce. There is grass everywhere, so they don’t have to worry about eating.

**Lions** have to worry about how many consecutive meals they have missed. If they miss too many, they will die. **Zebras** are tasty treats. **Lions** move around and reproduce as well.

**Programming Requirements**

Your **Critter** class must store the following data.

- Two integer values for x and y position of the critter.
- An integer value for the level of the critter in the food chain.
- A boolean value for if the critter is alive.

Your **Critter** class must have the following methods.

- **Critter( int x, int y, int level );** Sets the data members correctly. All critters are created alive. Allows any non-negative value for [x] and [y]. Any values less than 0 should be replaced with 0.
- **virtual ~Critter();** The destructor is required, but has and empty block of code for its body.
- **int getX( ) const;** Returns the x position of the critter.
- **int getY( ) const;** Returns the y position of the critter.
- **int getFoodChainLevel( ) const;** Return the food chain level.
- **bool isAlive( ) const;** Returns the alive status of the critter. If the critter is alive, make it not alive. Return **true** if the critter is made not alive. Otherwise, return **false**.
- **void setPosition( int x, int y );** Sets the position of the critter. Assumes [x] and [y] are allowed, does not verify them.
- **bool positionAvailable( int x, int y, std::vector< Critter* >& critters, int width, int height );** Returns **true** if position [x],[y] is a legal position and unoccupied. Otherwise, returns **false**. Legal positions must have x at least 0 and less than width and y at least 0 and less than height.
- **virtual bool move( std::vector< Critter* >& critters, int width, int height );** From the list of empty neighboring locations, randomly chooses one, and moves to it. If no locations are empty, do not move. Do not move to a negative x or y position. Do not move to [x = width] or [y = height]. Returns **true** if moved. Otherwise, returns **false**.
- **virtual bool eat( std::vector< Critter* >& critters ) = 0;** Abstract method, each critter type eats in its own way.
- **virtual bool reproduce( std::vector< Critter* >& critters ) = 0;** Abstract method, each critter type reproduces in its own way.

Your **Lion** class must have the following methods.

- **Lion( int x, int y );** All **Lions** have a food chain level of 10. Initialize the consecutively missed meal count to 0.
- **virtual ~Lion();** Required, with empty code block for body.
- **int getMissedMealCount( ) const;** Returns the number of consecutive missed meals.
- **Critter *findNeighborPrey( std::vector< Critter* >& critters ) const;** Find the first critter in the vector that is alive, has a lower food chain level than the lion, and is next to the lion, either vertically
or horizontally. If no such critter is found, return the null pointer (0).

- **virtual bool eat(std::vector< Critter* >& critters);** If no Zebra s are nearby, the Lion will miss a meal. If the Lion has missed 3 or more meals, then the Lion dies. If there is a Zebra next to the Lion, then the Lion moves to the location of the Zebra, the Lion will eat the Zebra and the Zebra dies. This should reset the number of consecutively missed meals to 0. Returns true if the Lion eats, otherwise returns false.

- **virtual bool reproduce(std::vector< Critter* >& critters);** Returns false, for now. You’ll need to have a statement: (void)critters in the body to remove the compiler warnings.

Your Zebra class must have the following methods.

- **Zebra(int x, int y);** All Zebras have a food chain level of 5.
- **virtual ~Zebra();** Required, with empty code block for body.
- **virtual bool eat(std::vector< Critter* >& critters);** Always returns false. You’ll need to have a statement: (void)critters in the body to remove the compiler warnings.
- **virtual bool reproduce(std::vector< Critter* >& critters);** Returns false, for now. You’ll need to have a statement: (void)critters in the body to remove the compiler warnings.

### Show Off Your Work

To receive credit for this assignment, you must complete the unit tests available in CodeGrinder.