

OOP 2nd Assignment / Task 6

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25th May 2024

Task

We are simulating the animals of the tundra. There are colonies of prey and predator animals. The number of animals in a colony affects the number of animals in other colonies. There are three predator species: the snowy owl, the arctic fox and the wolf. There are three kinds of prey: the lemming, the arctic hare and the gopher.

If the number of prey animals increases, predators can reproduce more quickly. If the number of prey is very large, most of them will wander away because they cannot find enough food. If the number of predators is large, the number of the prey decreases quicker as they are preyed upon.

Each colony has a name, a species, and the number of animals in the colony. The prey species are affected by the different predator species as follows. The number of animals in their own colony changes first, then they influence the predators.

Lemming: If they are preyed upon by a predator colony, the number of animals in their colony decreases by four times the number of animals in the predator colony. The number of animals in their colony doubles every second turn. If there are less than 20 animals in the colony, all predator colonies have 20% less offsprings. If there are more than 200 animals in the colony, the number of animals in the colony decreases to 30.

Hare: If they are preyed upon by a predator colony, the number of animals in their colony decreases by double the number of animals in the predator colony. The number of animals in their colony grows by 50 percent (to one and a half times their previous number) every second turn. If there are less than 10 animals in the colony, every predator colonies have 20% less offsprings. If there are more than 100 animals in the colony, the number of animals in the colony decreases to 20.

Gopher: If they are preyed upon by a predator colony, the number of animals in their colony decreases by double the number of animals in the predator colony. The number of animals in their colony doubles every fourth turn. If there are less than 30 animals in the colony, every predator colonies have 20% less offsprings. If there are more than 200 animals in the colony, the number of animals in the colony decreases to 40.

Predators choose and attack a prey colony randomly in each turn. If there are not enough animals in the attacked colony (for example, there are not four times the number of predators in a lemming colony), the number of predators also decreases: every fourth predator out of the ones who didn't get prey perishes.

Predators have offsprings every eighth turn. Normally, the snow owls have 1 offspring per 4 animals, the foxes have 3 offsprings per 4 animals, and the wolves have 2 offsprings per 4 animals. If the number of all prey animals is more than 10 times the number of predator animals, predators have 1 more offsprings: owls have 2 per 4 animals, foxes have 4 per 4 animals, and wolves have 3 per 4 animals.

The program should read the colonies from a text file. The first line contains the number of prey and predator colonies separated by a space. Each of the next lines contains the data of one colony separated by space: their name, their species, their starting number of animals. The species can be: o - owl, f - fox, w - wolf, l - lemming, h - hare, g - gopher.

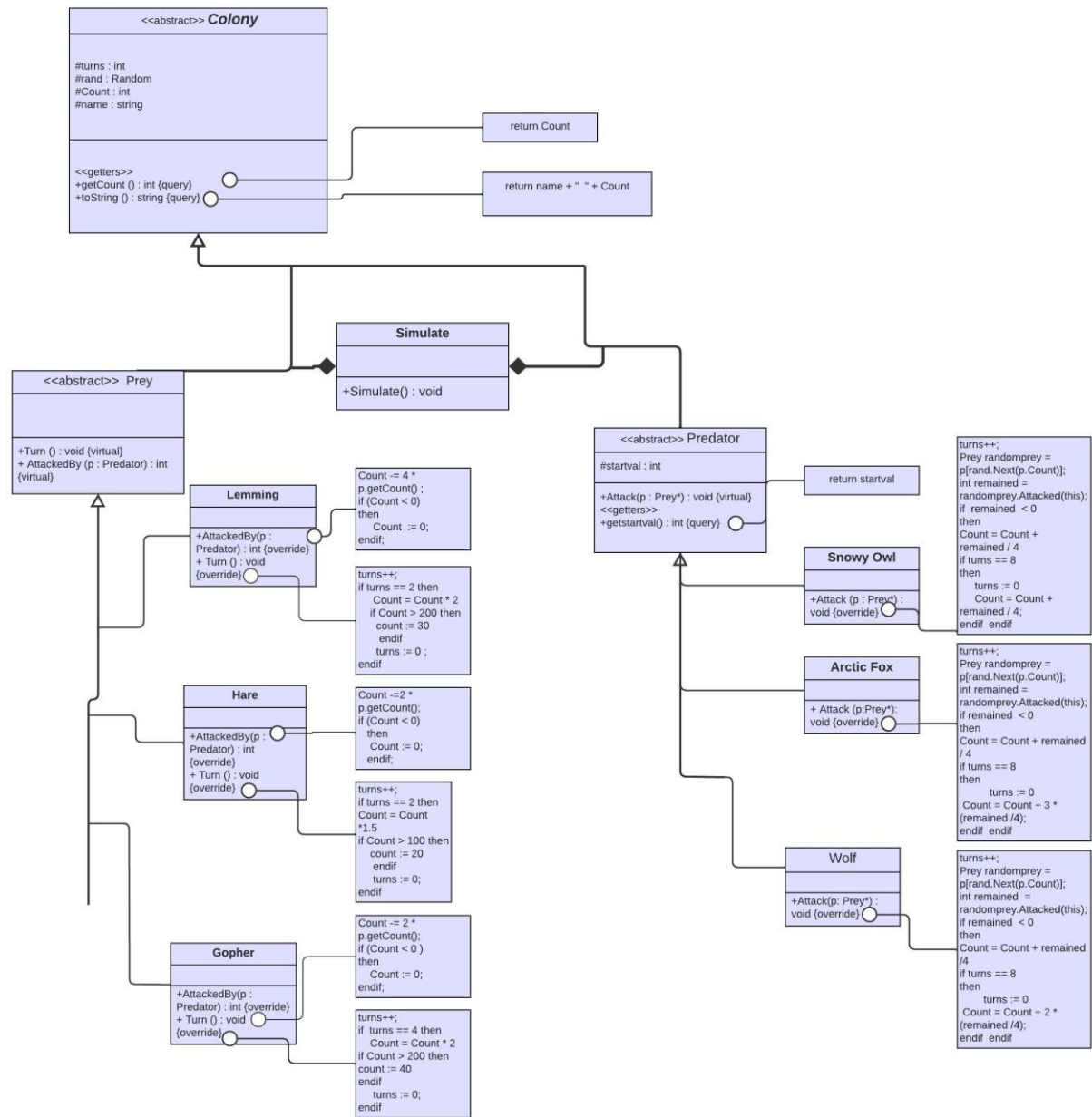
Simulate the process until each of the prey colonies becomes extinct or the number of prey animals quadruples compared to its starting value. Print the data of each colony in each turn.

Analysis

Preys	Getting preyed	Reproduce	Population decrease
Lemming	-4*predatorsCount	*2(every 2 nd turn)	> 200 = 30
Hare	-2*predatorsCount	*0.5 (every 2 nd turn)	>100 = 20
Gopher	-2*predatorsCount	*2(every 4 th turn)	>200 = 40

Predators	Prey	Reproduce
Snowy Owl	PredatorsCount/4 perishes	PredatorsCount/4*1
Arctic Fox	PredatorsCount/4 perishes	PredatorsCount/4*3
Wolf	PredatorsCount/4 perishes	PredatorsCount/4*2

UML Class Diagram



Simulation

Specification

$A = (\text{preys} : \text{Prey}^*, \text{predators} : \text{Predator}^*, \text{isExtinct} : \text{bool}, \text{isQuadruple} : \text{bool}, \text{daycnt} : \mathbb{Z})$

$\text{Pre} = (\text{preys} = \text{preys}' \text{ and } \text{predators} = \text{predators}', \text{preyCount} > 0 \text{ and } \text{predatorCount} > 0)$

$\text{Post} = i \in [0.. \text{predatorCount} - 1], \text{predators}[i].\text{Attack}(\text{preys})$

Pseudocode :

Simulate () :

int daycnt := 1, bool isExtinct := false , bool isQuadrupled := false

int[] startCount = new int [preyCount]

for k from 0 to preyCount – 1 :

 startCount[k] := preys[k].getCount();

While not isExtinct and not isQuadrupled :

 for i from 0 to preyCount - 1:

 Preys[i].Turn();

if preys[i].getCount () <= 0 :

 IsExtinct := true

 print “Colony:” , preys[i].toString();

 Break the while loop;

if preys[i].getCount >= 4 * startCount[i] :

 IsQuadrupled := true;

 Break the while loop;

If isExtinct or isQuadrupled : break

for j from 0 to predatorsCount - 1:

 Predators[j].Attack(preys);

daycnt++ ;

Testing

Testing Prey and Predator inherited classes:

- 1) TestLemm() : this test case checks that the counts will be the same.
- 2) TestNegative(): if the value is negative, throws an exception
- 3) TestDouble()
- 4) TestAttacked(): testing the value after preys getting preyed
- 5) TestAttackedHare()
- 6) GhopherTest()
- 7) TestAttackOwl()
- 8) TestAttackFox()