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Assignment 2nd. Task 6th.

Group: №6

Task

We are simulating the animals of the tundra. There are colonies of prey and predator animals. The number of animals in a colony affect 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 increase, 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 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 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 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.

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

In the tundra simulation, there are colonies of animals divided into predators and prey:

- Predators: Snowy Owl, Arctic Fox, and Wolf.
- Prey: Lemming, Arctic Hare, and Gopher.

Snowy Owl:

Reproduction	every 8th turn	Increase 1/4
Decrease	every turn	1/4 among didn't get perish

Arctic Fox:

Reproduction	every 8th turn	Increase 3/4
Decrease	every turn	1/4 among didn't get perish

Wolf:

Reproduction	every 8th turn	Increase 2/4
Decrease	every turn	1/4 among didn't get perish

Lemming:

Reproduction	every 2nd turn	Doubles
Decrease	when attacked	Four times*

* If there are more than 200 animals in the colony, the number of animals in the colony decreases to 30.

Arctic Hare:

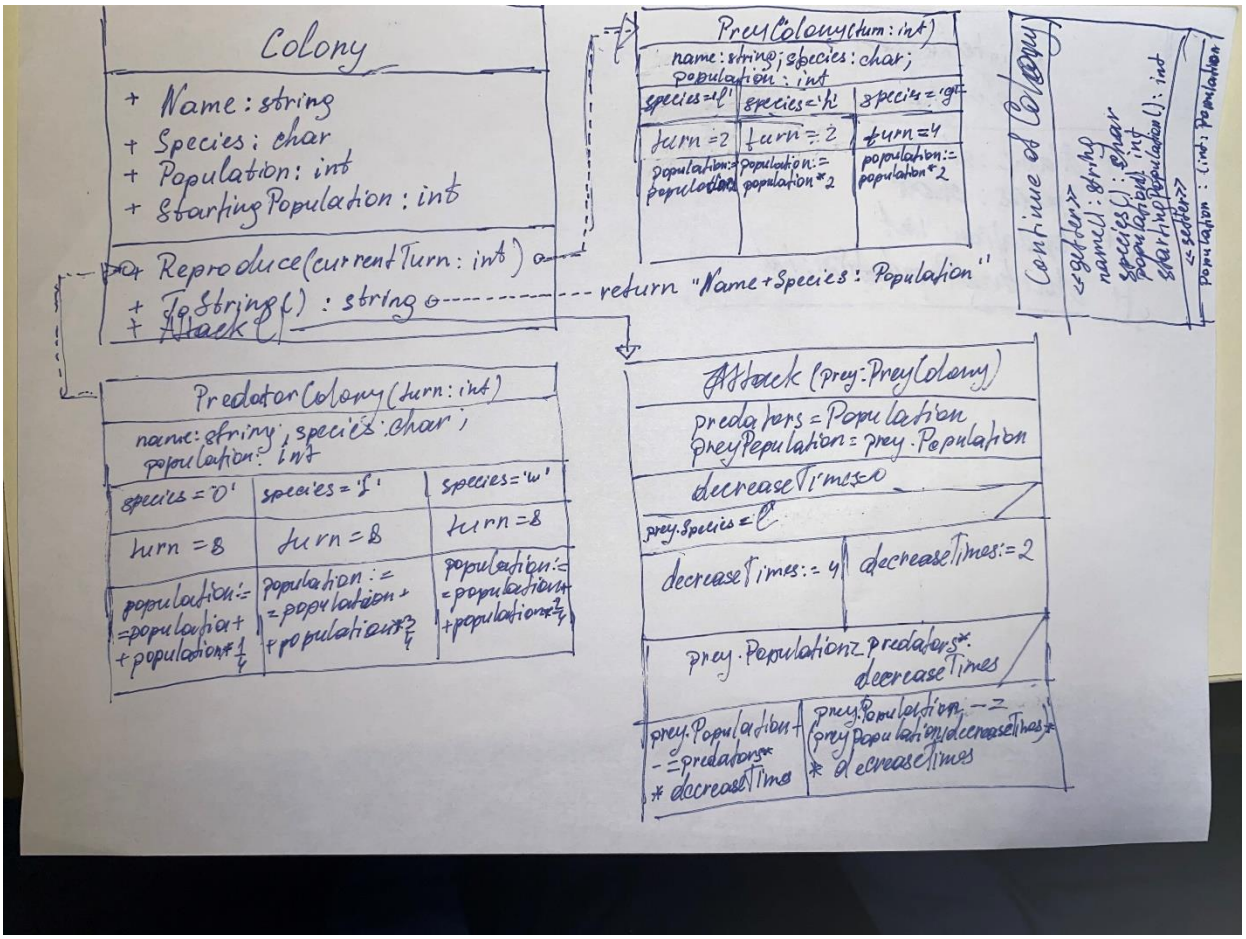
Reproduction	every 2nd turn	50% percent
Decrease	when attacked	Two times*

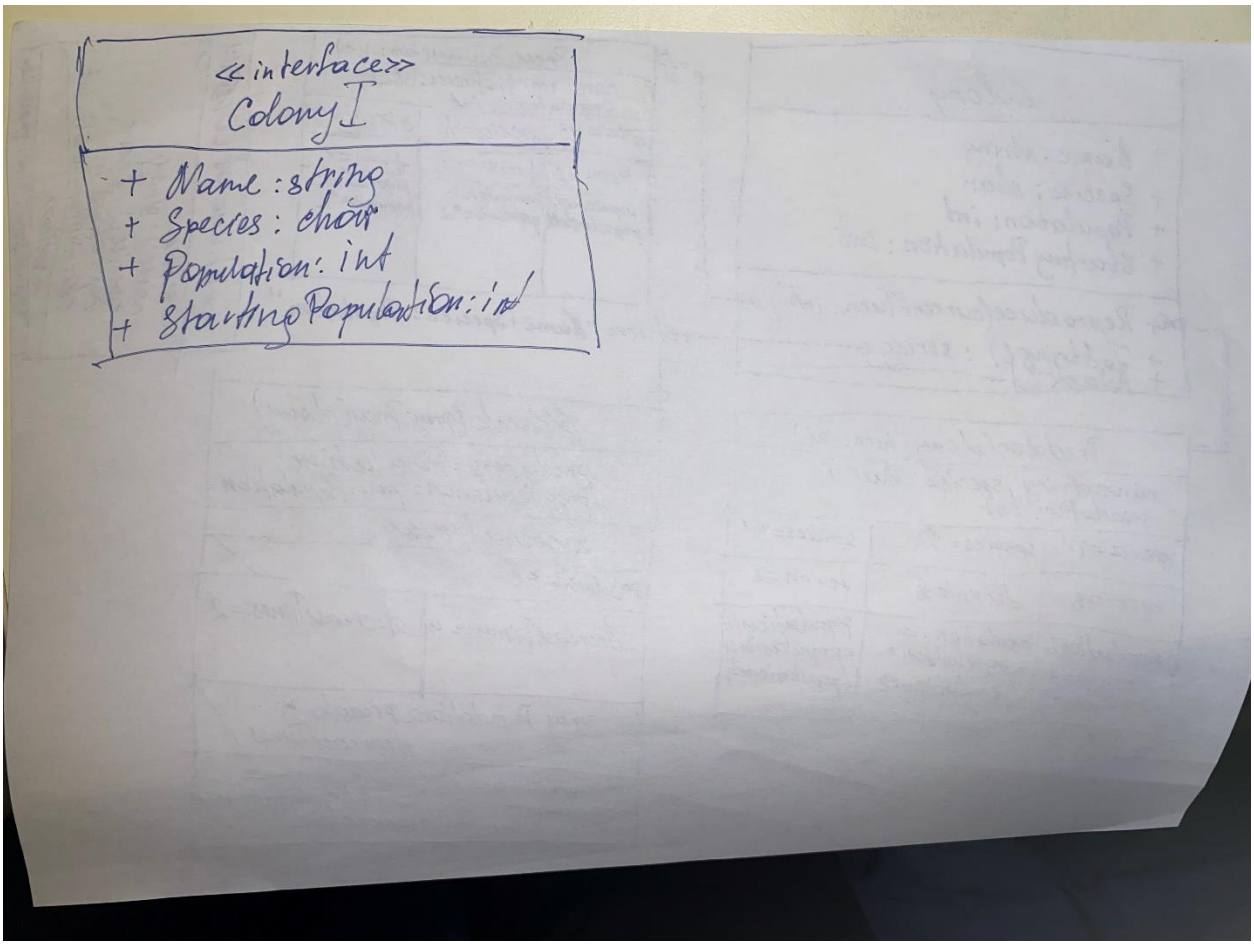
* If there are more than 100 animals in the colony, the number of animals in the colony decreases to 20.

Gopher:

Reproduction	every 4th turn	Doubles
Decrease	when attacked	Two times*

* If there are more than 200 animals in the colony, the number of animals in the colony decreases to 40.





Simulation Process

1. Initialization: Read the colonies from the file and initialize their populations.

2. Simulation Loop: Continue the simulation in turns until all prey colonies become extinct or their populations quadruple compared to the starting population.

- Reproduction: Prey colonies reproduce based on the turn and their species-specific rules.
- Predator Attack: Predators choose and attack a random prey colony.
- Predator Reproduction: Predators reproduce every eighth turn based on their species-specific rules.
- Termination Check: Check if all prey colonies are extinct or their populations have quadrupled.

Output

For each turn, print the current state of all colonies, showing the name, species, and population.

Analogy

First Component of the Value of Function race()

enor(E)	i=1..n
f(e)	$race(creatures[i],track)$1
S	creatures
H, +, 0	$Creature*,\oplus,creatures[i]$

Second Component of the Value of Function race()

enor(E)	i=1..ni=1..n
f(e)	$race(creatures[i],track)2race(creatures[i],track)$2
s	track
H, +, 0	$Ground*,\oplus,trackGround*,\oplus,track$
	$a\oplus b::=ba\oplus b::=b$

Alive Component of the Value of Function race()

enor(E)	i=1..ni=1..n
f(e)	$\langle creatures[i]\rangle$ if creatures[i].alive()$\langle creatures[i]\rangle$ if creatures[i].alive()
s	alive
H, +, 0	$Creature*,\oplus,\langle\rangle Creature*,\oplus,\langle\rangle$

Classes and Methods

Colony Class: Base class for all colonies, containing properties for name, species, population, and starting population. Contains an abstract method Reproduce.

PreyColony Class: Inherits from Colony and implements the Reproduce method based on species-specific rules.

PredatorColony Class: Inherits from Colony, implements the Reproduce method, and includes methods for attacking prey colonies and calculating offspring.

Testing

Ensure to test the simulation with various configurations:

Different initial populations of prey and predator colonies.

Edge cases where prey population exceeds the maximum threshold or predators fail to find enough prey.

Scenarios where all prey become extinct quickly or their population grows significantly.

The simulation output should reflect the correct population changes and interactions between colonies for each turn.

Testing

Grey Box Test Cases

Outer Loop (Summation)

1. Length-Based:

- Zero Creature:

  - Test with no creatures in the simulation to ensure the program handles empty input correctly.

- One Creature:

  - Test with a single prey colony and a single predator colony to check if the simulation handles minimal input correctly.

- More Creatures:

  - Test with multiple prey and predator colonies to ensure the simulation processes multiple colonies accurately.

2. First and Last:

- First Creature Survives or Not the Competition:

- Ensure that the first prey colony listed can survive through multiple turns and that its survival or extinction is handled correctly.

- Last Creature Survives or Not the Competition:

- Verify that the last prey colony listed is processed correctly and its survival or extinction is accurately handled.

Inner Loop (Summation)

1. Length-Based:

- One Creature on a Zero-Long Track:

- This case is not applicable as a zero-length track cannot exist in the context of the simulation.

- One Creature on a One-Long Track Traverses Properly:

- Ensure that a single creature (prey or predator) in a colony processes its turn accurately, including reproduction and predation.

- One Creature on a Longer Track (Survives or Dies):

- Test a single creature's ability to survive or die based on interactions over multiple turns and different conditions.

2. First and Last:

- First Ground of the Track Traverses Properly Depending on the Species of the Creature:**

- Verify that the first prey or predator colony interacts correctly with the simulation rules, including the attack and reproduction mechanisms.

- Last Ground of the Track Traverses Properly Depending on the Species of the Creature:**

- Ensure that the last prey or predator colony is processed correctly in terms of attacks, reproduction, and population changes.

Examination of Function `traverse()`

Nine different cases depending on the creature and the ground:

1. Lemming on typical ground (without predator attack)
2. Lemming on typical ground (with predator attack)
3. Hare on typical ground (without predator attack)
4. Hare on typical ground (with predator attack)
5. Gopher on typical ground (without predator attack)
6. Gopher on typical ground (with predator attack)
7. Owl attacking lemming
8. Fox attacking hare
9. Wolf attacking gopher