Predator-Prey Simulation

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Description

Running Simulator

To run the code, the main function can be called from the Simulator class which creates a new SimulatorView object of a specified default depth and width and begins to run a simulation of 400 steps / 200 days. Alternatively, an object can be created manually, either with the default depth and width or with other specified values which brings up the simulator to allow all simulation controls. Population shown signifies the population on the field, some actors can act and exist off the field.

Food Chain
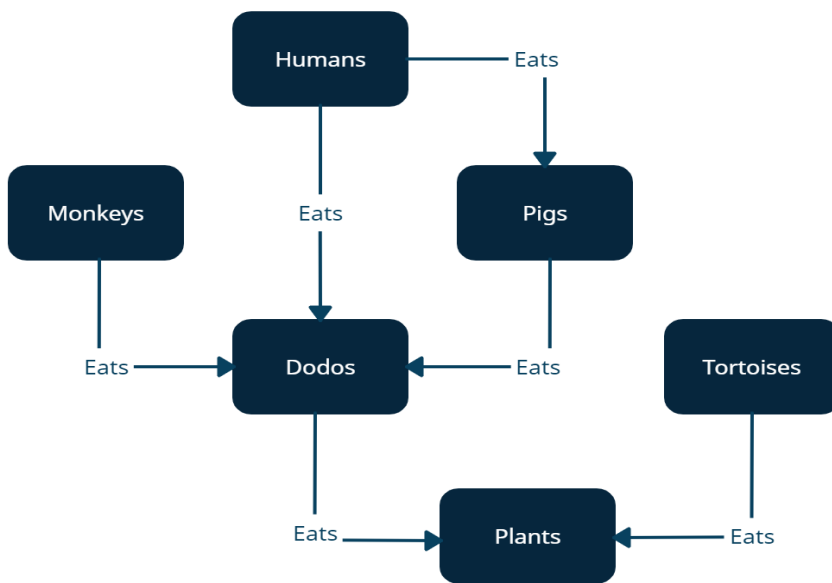
Species
Humans - Actor | Animal
Monkeys - Actor | Animal
Dodos - Actor | Animal
Tortoises - Actor | Animal
Pigs - Actor | Animal
Plants - Actor

Food Chain
Key: Predator -> Prey
Humans -> Pigs | Dodos
Monkeys -> Dodos
Pigs -> Dodos
Dodos -> Plants
Tortoise -> Plants

All Actors

All actors have a separate set of day and night actions. They also have a differing set of probabilities for certain actions to happen based on the current weather.

Plants

During the day: plants can grow older, die of old age and breed.
During the night: plants can breed (at a decreased rate).
Plant breeding is increased in rain and sun, while decreased in the snow. Growth is simulated through age, as well as the food value they provide being curved based on

their age, maxing out at a predetermined value, sometime around ¼ through their lifespan.

All Animals
All animals can breed with animals of the same species and opposite gender in adjacent locations once they've reached the minimum breeding age. All animals can die from old age and hunger, as well as move around the field. All animals can be infected by a virus, spread the virus to all other animals, have a chance of being cured of the virus naturally, and have a probability of dying from the virus. Breeding probability is increased in sunny conditions and decreased in rain, snow and fog. The probability of an animal hunting its prey successfully is decreased in rain, fog and snow. Growth is simulated through age, as well as the food value they provide being curved based on their age, maxing out at a predetermined value, sometime around a quarter through their lifespan.

Humans
During the day: humans can die of old age, hunger, overcrowding or infection. They can be cured or spread a virus, as well as trying to hunt dodos and pigs, and trying to move into a different position.
During the night: humans sleep, can die of infection, give birth, be cured, or spread a virus.

Dodos
During the day: dodos can die of old age, hunger, overcrowding or infection. They try to reproduce, can be cured or spread a virus, as well as trying to find plants, and trying to move into a different position.
During the night: dodos sleep, can die of infection. They can be cured or spread a virus, as well as trying to attack and kill all their known predators in their sleep.

Pigs
During the day: pigs can die of old age, hunger, overcrowding or infection. They try to reproduce, can be cured or spread a virus, as well as trying to hunt dodos, and trying to move into a different position.
During the night: pigs sleep and can die of infection.

Tortoises
During the day: tortoises can die of old age, hunger, overcrowding or infection. They try to reproduce, can be cured or spread a virus, as well as trying to find plants, and trying to move into a different position.
During the night: tortoises sleep, can be cured or spread a virus.

Monkeys
During the day: monkeys can die of old age, hunger, overcrowding or infection. They try to reproduce, can be cured or spread a virus, as well as trying to hunt dodos, and trying to move into a different position.
During the night: monkeys sleep and can die of infection.

Challenges

Visibility Toggles
Actors (Animals and Plants) can be toggled in and out of view via toggle buttons for each actor in the GUI. This can be used to focus on specific interactions, and view how certain actors interact with one another, and the effects on a specific set of species. A reset colour button is provided to reset all the animals to be visible on the GUI. The buttons when pressed repaint the field with / without the toggled species when simulating and paused. It can be used to analyse simulation field data both when paused and unpaused.

Weather Controls
Within the GUI, users can set random weather, or specify what kind of weather they want the simulation to experience. This can be changed anytime throughout the simulation, with the changes being made to the next step simulated.

Simulator Speed Controls
The time delay between steps can be increased and decreased mid simulation based on a fixed set of values, using the speed up and slow down buttons in the GUI.

Pausing/Playing Simulator
A running simulation can be paused to stop and view a given field in more detail, as well as enable users to run a single step at their own pace via the run single step button. The play button can be used to play the simulation when paused.

Shutdown Simulator
A given simulator can be closed within the GUI by the shutdown button, closing both the GUI and destroying the simulator object

Disease
Disease is randomly generated at the start and given to a randomised number of animals. Infected animals can die of infection, as well as spread and be cured of disease.

Weather Conditions
Weather conditions are set across the whole board, with the options of sunny, rainy, foggy and snowy. The weather affects the chances of successful plant and animal birth as well as the chances of animals successfully finding and hunting down their prey.

Plant Growth
Plants do not move and display growth via age, as well as the number of days they provide to the animal that eats it is curved based on an algorithm with a set max value, maxing out at around a quarter of their maximum age. Dodos and Tortoises will die if they don't eat a plant for a given number of days

Run Simulation in GUI
Within the GUI, you can run the long simulation (200 days), short simulation (5 days) or run single step methods, starting up and displaying a simulation within the GUI without having to touch the simulator object.
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Reset Simulator Field
The simulator field can be reset within the GUI via the reset field button. This stops the simulation, then clears and repopulates the field from the beginning.

Viability Stopping
The simulator is made to stop running any further steps when only one animal species is left alive. From this point, the field must be reset for any further simulations to be made.

Animal Growth
Animals display growth via age, as well as the number of days they provide to the animal that eats it is curved based on an algorithm with a set max value, maxing out at around a quarter of their maximum age.

Warnings/Updates
A warning will be printed to the terminal if the probability for total animal spawning is over 1 for the possibility of unexpected spawn behaviour, alongside a warning for if the total weather probability is not equal to 1 and that some unexpected weather behaviour may occur, protected by a return Sunny clause. Updates are sent to the terminal when the simulator is paused, shutdown, stopped due to steps reached and stopped due to one remaining animal species. Updates / Alerts are also given for when a repeat action is made, such as pausing when paused, and setting the current weather again, as well as when the simulator speed limits have been reached.