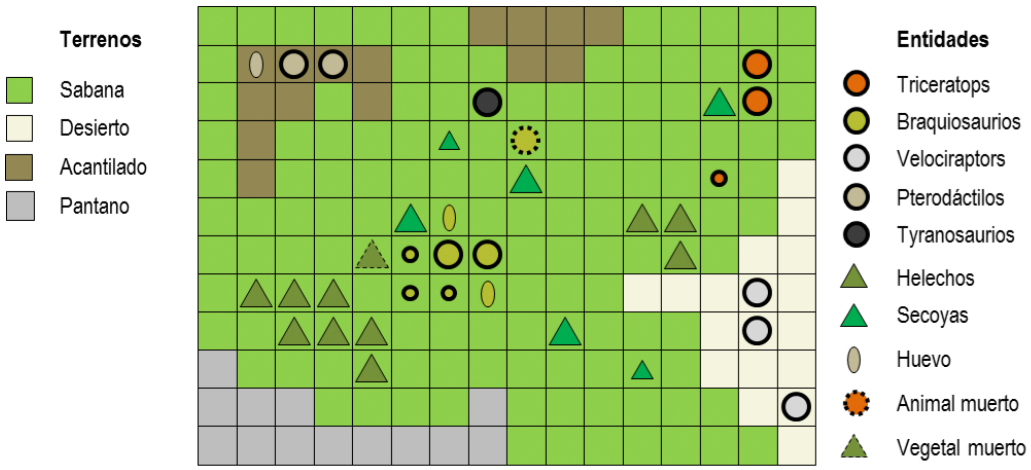
JURASSIC PARK

It is desired to simulate the behavior of animals in a Theme Park with creatures from the Jurassic period such as triceratops, pteranodontes, brachiosaurs, velociraptors and tyrannosaurs. In addition you can have different types of vegetation: bushes (ferns) and trees (redwoods).
The simulation is separated into units of time called cycles. A cycle will allow each entity to perform certain action (attack, eat, mate or move depending on their priorities). In each cycle, all entities "grow" (if it is alive, it becomes older) or decompose (if it is dead, it loses weight due to decomposition). The order in which the entity is selected to perform an action will be random in each cycle, but only one action per individual is performed.
All beings have an adult age (valid to think about reproducing) and an age limit (after which they die with the exception of the redwoods that live "eternally").
The park is simulated by a two-dimensional matrix of squares. In each box there will be a single element (animal or vegetable). Figure 1 shows an example of a park. In all the figures of this document the animals will be represented with circles and the vegetables with triangles. The size of the figure determines whether it is a young or adult being. The color of the box will determine the type of terrain. The legend will be the same for all the images that illustrate a park.



Translation:

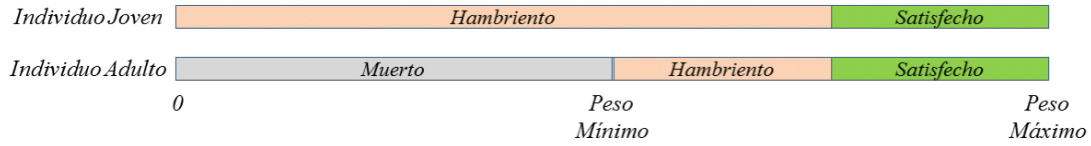
- Desierto -> Desert
- Acantilado -> Cliff
- Pantano -> Swamp
- Helechos -> Ferns
- Huevo -> Egg
- Secoya -> Requoia
- Animal Muerto -> Dead Animal
- Vegetal Muerto -> Dead Vegetable

CONCEPTS OF SIMULATION

In addition to age (given in number of cycles), entities have a set of attributes that can vary during the simulation.

WEIGHT

All entities have a current weight and two values: minimum weight (less weight allowed for an adult creature to live) and maximum weight (greater weight allowed, if this weight is exceeded the creature will not want to eat or grow more). In each cycle the animals lose a fixed weight due to hunger (dependent value of each species). Animals are obligated to eat if they are hungry and there is food nearby, even when they are in the presence of a predator. The animal is hungry if its weight is below the average value between the minimum weight and the maximum weight (see Figure 2).



Translation:

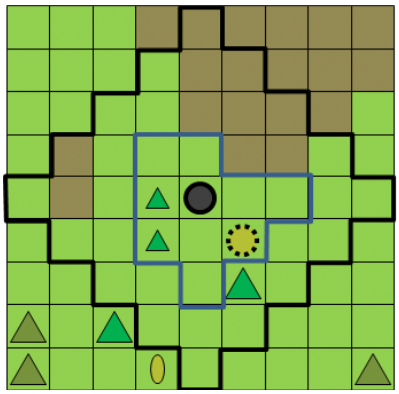
- Hambriento -> Hungry
- Muerto -> Dead
- Satisfecho -> Satisfied
- Peso minimo -> Minimum Weight
- Peso maximo -> Maximum Weight
- Individuo Joven -> Young Individual
- Individuo Adulto -> Adult Individual

When a baby is born, it will have weight equal to the minimum weight of its species. If a young creature reaches weight or dies. If a young creature reaches maturity below its minimum weight, it dies.
If a living being dies, it decomposes, losing a certain weight value until it reaches 0 (fixed value that only depends on whether it is an animal or a plant). Every body with weight 0 disappears automatically from the simulation.

POSITIONING

An animal can move a certain number of squares in each cycle. These boxes must form a "free" path of adjacent squares with common sides. The number of steps in the movement is determined by each species and is equal to its scope of action. The vegetation does not move. The terrain in the park can be desert, savanna, swamp or mountainous. These lands can prevent the growth of vegetation or the positioning of a certain species. For example: vegetation does not grow in the desert, and in the cliff there is no vegetation or terrestrial dinosaurs. The entities present in the terrain can be obstacles to movement, with the exception of the Pteranodontes, who, like flying, are not obstacles and nothing is an obstacle for them.

The animals have a range of vision (it determines the squares of the park of which they have knowledge) and a scope of action (it determines the squares that can accede to attack or to eat). The vision reaches every square at a certain distance, regardless of the obstacles, but the action is only possible for those spaces accessible from the current position.



(REACHABLE BOXES FOR A T. REX WITH 4 VISION AND 2 REACH)

REPRODUCTION AND PAIRING

The vegetation is reproduced by spores (ferns) and by seeds (conifers). In each cycle, a plant with an adult age can spread a spore or seed to a random park square that is at a certain distance from the plant (reach). So that the plant in said box can be born it must be unoccupied and correspond to a meadow.

Dinosaurs can be female or male. In a cycle, a male that is of adult age can mate with a female that is within reach, that has a neighboring empty box (valid to deposit the egg) and that is not guarding a previously deposited egg.

The duration of gestation of the egg is a certain number of cycles for each species. The weight of an egg is equal to half the minimum weight of the species and at birth a new young individual with equal probability of being male or female will emerge.

FEEDING

All living beings need to feed. The vegetation acquires its nutrients from the ground (they can only live in the savannahs) and increase their weight to a certain extent until they reach their maximum weight. The sequoias in their adult age are of such size that they block sunlight from their neighboring cells so that no other plant can grow on them. If a sequoia becomes adult, all the plants around it automatically die.

The herbivores only eat live vegetation. In each cycle they are able to "detach" a certain portion of a plant accessible from their position. The amount of food consumed is subtracted from the weight of the plant and added to the weight of the animal. The plant dies if the herbivore devours until leaving the plant with less than its minimum weight. The herbivores will eat from any plant reachable from them in a random way (which reduces the likelihood that they will completely extinguish a plant).

Carnivores only eat dead meat or eggs. In each cycle they "detach" a certain portion of the dead body or the broken egg accessible from its position. The amount of food consumed is

subtracted from the weight of the dead animal or egg, and added to the animal's weight. Animals do not practice cannibalism with the flesh of dead animals or eggs of their own species.

ATTACK AND DEFENSE

Carnivores attack to kill their prey (live animal or egg). Animals do not attack if they know they will lose the fight. Each species has an attack value and a defense value. If the attack value of a predator is greater than that of defense of the prey then the predator wins and as a consequence the prey dies.

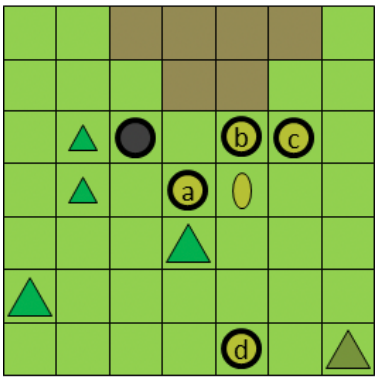
If a carnivore is within reach of a mother in the custody of an egg and this has greater attack value than the carnivore's defense then it will attack to kill (even if it is not hungry or is not carnivorous). Mothers do not give up their eggs until they are born, even if they are hungry.

ATTACK AND DEFENSE MODIFIERS

The value of attack or defense of an individual is multiplied by the ratio between the current weight and the maximum weight.

If a mother is defending an egg (the egg is within reach), then the mother's defense value doubles. The eggs have no attack or defense, however, attacking an egg that is being protected by the mother is equivalent to attacking the mother.

Animals that live in a pack help each other, both at the time of attack and to defend themselves. To the value of an attacker is added the sum of all attack values of the individuals of his species that have the prey in question within reach. The defense value of a prey that lives in a herd is added to the defense values of all the individuals of the same species that are within its reach. If a prey dies, the individuals in the pack will not be affected.



(ATTACK OF A T. REX TO A HERD OF BRAQUIOSAURIOS)

Figure 4 shows a scenario in which a tyrannosaur attempts to attack a brachyanosurus herd. Suppose the tyrannosaur has 35 pts of attack and 18 pts of defense and the brachiosaurus has 10 pts of attack and 15 pts of defense and that all They have their weight at the maximum. The tyrannosaur can attack both "a" and "b". Against "b" can not because it helps individuals "a" and "c" adding a total of 45 defense ptos, however against "a" wins because only help "b" and add 30 pts of defense against 35 pts of tyrannosaurus attack. If the brachiosaurus "a" were a mother guarding the egg on its right, then the Tyrannosaurus could not face it since it would double its defense ().

COMMUNICATION

Pack animals can communicate. In each cycle the animals will announce to the other individuals of the herd that they are within their visual range, the presence of food or enemies in their area.

If an animal is "lost" (it has no companions in its visual area) it can perform the action of sending a cry of help that travels twice its visual range (it will not be able to move in that cycle). If in this greater area one of its species is found, the call is returned and with it you can identify the position of your companions even when you do not see them.

The individuals that walk in packs tend to be close, that is, if they are not hungry or able to mate, nor are they fleeing from a predator, they will choose to move if possible to a space within the reach of a partner.

BEHAVIOR OF SPECIES

In each cycle, each individual must make a decision about what to do. This decision is determined instinctively by characteristics of each species. If an individual can not make any decision (can not eat, move, or mate, etc.) then it will be analyzed again at the end of the cycle (but as part of the same cycle). If after this second opportunity he could not perform any action, he will say that he was stagnant and must pass the cycle without moving.

BRAQUIOSAURIO

Food: Herbivorous. It feeds on redwood leaves. Young individuals will opt for ferns (shrubs) or young redwoods.
Coexistence: Pack.
Weight: 20 T
Scope of Vision: 7 boxes.
Scope of Action: 2 boxes.
Attack: Low
Defense: High
Habitat: May be in swamps, deserts and meadows. Behavior:
It will try to pair only when it is over () the maximum weight. He will not try to flee from the attackers.

TRICERATOPS

Food: Herbivorous. It feeds on young ferns or redwoods.
Coexistence: Pack.
Weight: 6 T
Scope of Vision: 5 boxes. Scope of Action: 4 squares. Attack: High
Defense: High
Habitat: They are located in deserts and meadows.
Behavior:
He will try to flee the attackers as long as he is not hungry and has food nearby.
He will try to mate as long as he is not hungry.

PTERANODONTE
Feeding: Carnivore (scavenger). Coexistence: Solitary.
Weight: 1 T
Scope of Vision: 7 boxes.
Scope of Action: 3 boxes.
Attack: Low
Defense: Low
Habitat: It can be in any terrain. Behavior:
The pteranodons fly by. They lay their eggs on the cliffs safe from other predators.
They do not need to flee from predators.
He will try to mate as long as he is not hungry.

VELOCIRAPTOR
Food: Carnivore. Coexistence: Pack.
Weight: 0.6 T
Scope of Vision: 5 boxes. Scope of Action: 5 boxes. Attack: Moderate
Defense: Low
Habitat: Prairies and desert.
Behavior:
He will try to flee the attackers as long as he is not hungry and has food nearby.
They mate as long as they are not hungry.

T-REX
Food: Carnivore. Coexistence: Solitary.
Weight: 10 T
Scope of Vision: 5 boxes. Scope of Action: 2 boxes. Attack: Very High
Defense: High
Habitat: Prairies and desert. Behavior:
It will try to mate only when it is over (It will not try to flee from the attackers.

GIANT SECOYA
Weight: 10 T Scope: 5 boxes

FERN
Weight: 1 T Reach: 2 boxes

THE USER APPLICATION
You must show the operation of the simulation through a graphical user interface developed in Windows Forms or Windows Presentation Foundation.
The application must have two areas: configuration and simulation. In the Configuration area, the park's terrain is designed (specifying the type of terrain for each square) similar to how the icon was painted in the first task (Paint-style tools).

The parameters of maximum age, age of adulthood, minimum weight, maximum, emaciation due to malnutrition, etc. they can be configured for each species.
An option may generate random individuals throughout the map (in valid positions and attending to certain quantities entered by the user). In addition there will be a way to "locate" manually the individuals (vegetation or animal).
A second area of the application is responsible for showing the simulation of the park. Your application should be able to show each step of the simulation between the action of one individual and another, as well as the execution of a complete cycle. An "animate" option will allow the cycles to pass each a certain time interval without having to be executed manually.

REPORT

One of the controls of the application should show text messages of what happens during the simulation. For example:

Cycle 0
Tyrannosaurus (3,4) attacks Brachiosaurus (2,5) [35 vs 15]
Triceratops (6,4) eats Fern (6,2) [0.5 T]

Cycle 1
Tyrannosaurus (3,4) eats Brachiosaurus (2,5) [1 T]