Uta Stansburiana Sillycon Desert

a Uta Stansburiana Rock-Paper-Scissor population model

Presented by: **Alessandro Scala** and **Salvatore Salerno**

Academic Year 2023/2024

Outline

1. Introduction to the lizard species
2. Rock-Paper-Scissors Pattern
3. Using the Godot Engine
4. Modelling the morphs
5. Modelling behaviours
6. Conclusions

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Introduction to the lizard species

“Uta stansburiana” is a species of side-blotched lizards mainly known for the peculiar behaviour of the three different male morphs in acquiring mates.

- The morph is characterized by the color of their neck: Orange, Blue or Yellow

- They live in deserts near the western part of the United States or in Northern Mexico.

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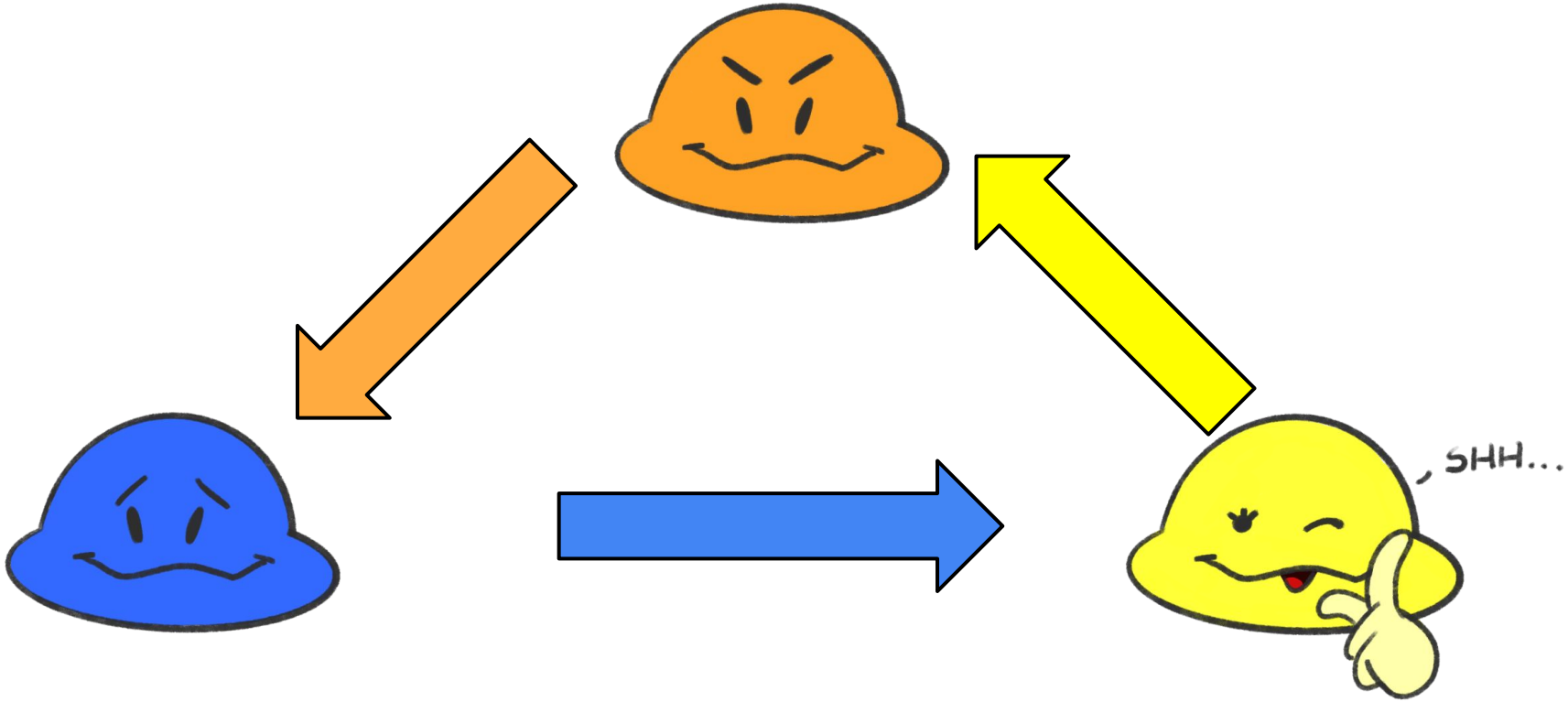
Rock-Paper-Scissors Pattern



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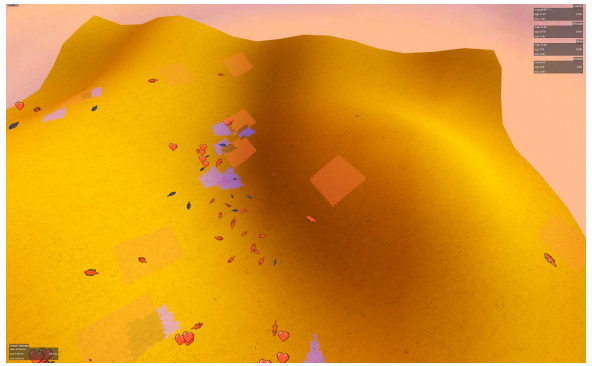
Using the Godot Engine

We decided to use the Godot Engine instead of the more common NetLogo language because:

- Using a 3D engine we were able to have a better visualization of habitats, showing hills and slopes.
- The customizability of GDScript allowed us to better model the complex behaviour of the various morph and interactions between them.
- We were able to code more realistics and precise physics for our lizards.
- The desert is procedurally generated in each run.



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Modelling the lizards

The lizards are independent agents who, based on their sex and morph, behave and interact differently. To model them, we decided to create a common class that shares the common parameters whose values vary depending on the specific lizard:

SEX:
Male || Female

MORPH:
- **Male:** Orange || Yellow || Blue
- **Female:** Orange || Yellow

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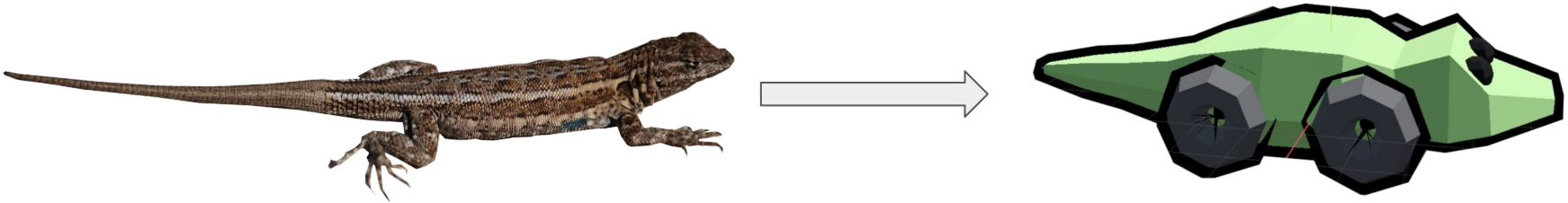
SIZE:

- **baseSize** = [20…40]mm
- **size** = baseSize + (male ? 10 : 0) + (orange ? 10 : 0)

AGE:

Baby || Adult



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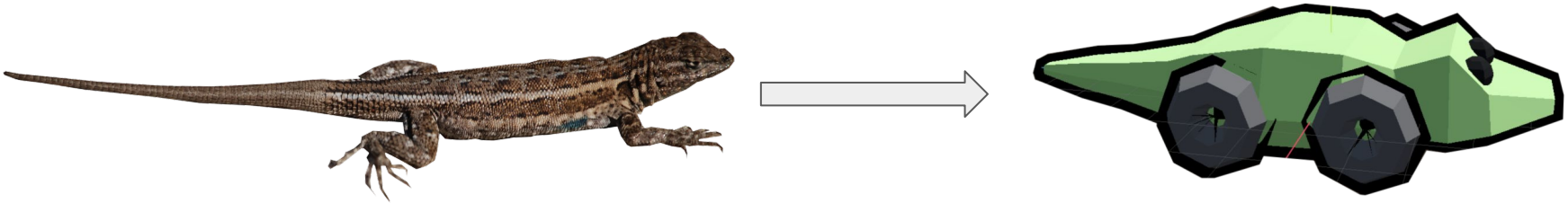
SPEED:

- **baseSpeed** = [2…3]m/h
- **speed** = baseSpeed + (male ? 1 : 0) + (orange ? 0.4 : 0)

LIFETIME:

- **baseLife** = [1…3] years
- **lifetime** = baseLife + (male? -1 :0) + (orange ? -0.5 : 0)



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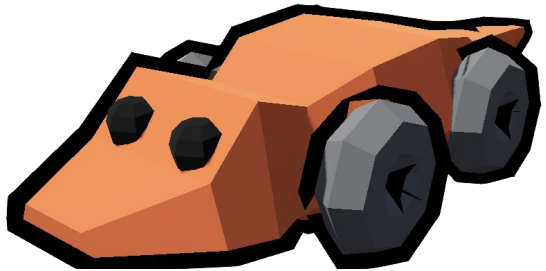
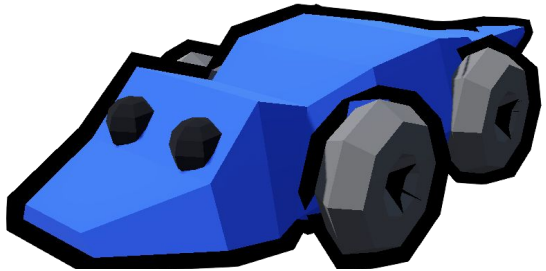
Modelling the Orange Morph

- They are the largest in size and most aggressive morph, winning most of their fights.
- Their territory extends up to 100 m^2 in which they keep a large number of females.
- They have a significantly reduced yearly survival rate compared to the other two morphs.
- They are adept at stealing territories from blue-throated individuals, but are vulnerable to the yellow morph.



Modelling the Blue Morph

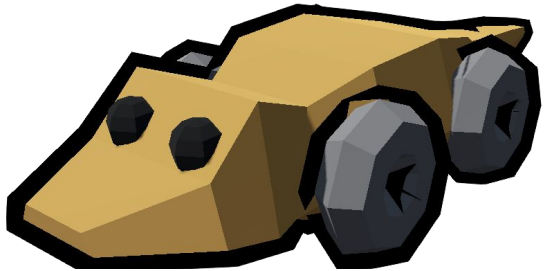
- They are of intermediate size and less aggressive than the orange lizards, losing most of the fights against them.
- Their territory is small, guarding only one female.
- They are better at catching yellow-throated sneakers,but are also susceptible to having their territory stolen by the more aggressive orange-throated males.



Modelling the Yellow Morph

- Their looks and behavior is similar to females, and they typically mimic female "rejection" displays when they encounter dominant orange- or blue-throated males.

- Unlike the other morphs, yellow-throated males do not hold territories.



Modelling the Yellow Morph - Bluecoming

If a blue dominant male dies in the proximity of a yellow-throated one, it occurs that the latters changes is morph, giving up its female mimicry and adopting the “dominant” blue morph’s behavior pattern.

Modelling the Females

- Females can either roam around the desert or stay in a male territory.
- They pick a territory owned by a male and stay on it until her or the owner dies.
- On average their lifespan is higher than the males.
- There exist no blue-throated female lizards.

Modelling the Children

- Children are ignored by adults regardless of their sex.
- Once maturity is reached, they are dismissed from the territory by the male and females.
- We assume that children do not die.

Alleles combinations

OY || OB || OO || BO || YO

BB

YB || YY || BY

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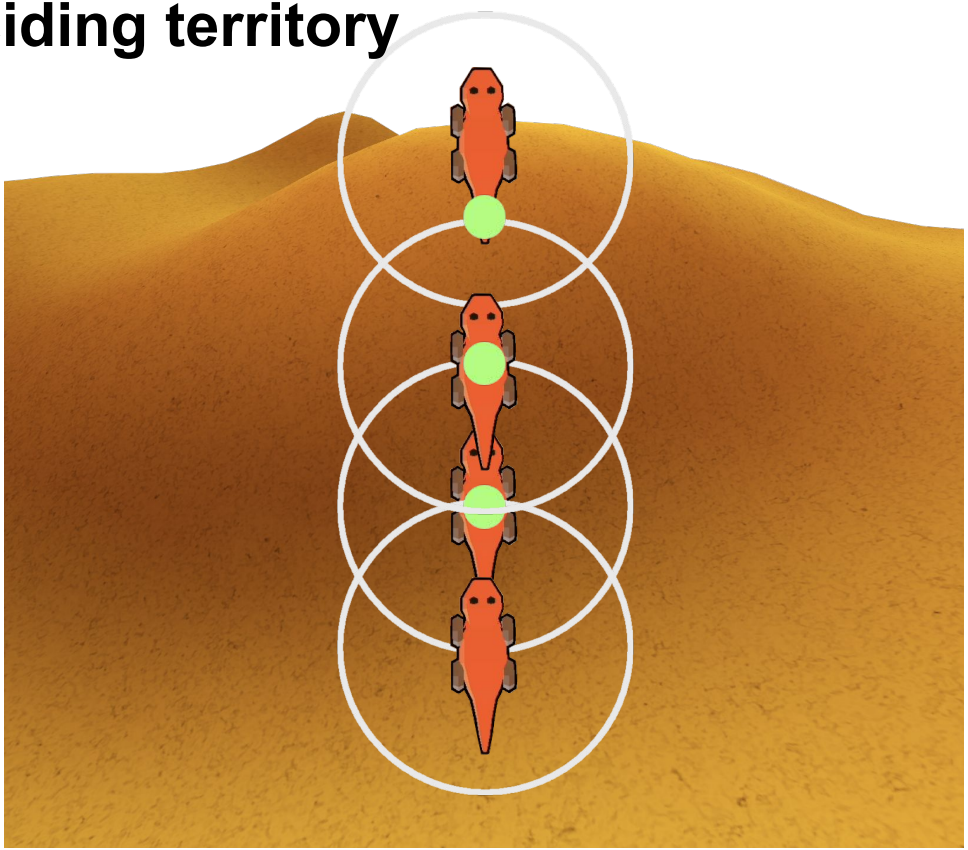
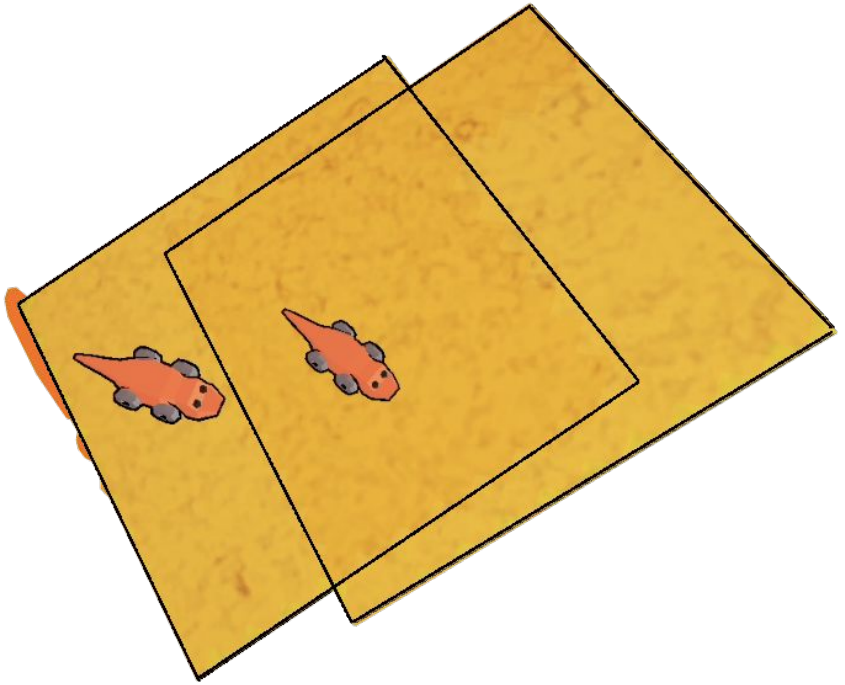
Modelling behaviours: deciding territory

- A male will search the highest point in the area around him, reaching it and repeating the process.
- It will stop if it does not find a better point compared to where it stands or if it is tired of searching.
- What they find is not always the most strategic point in the whole desert, but the local maximum.



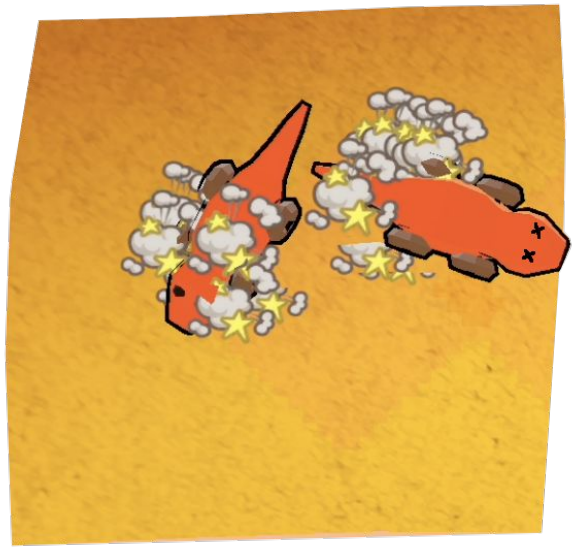
Modelling behaviours: managing a territory

- When a male has a territory, it roams around it.
- When another male happens to create a territory overlapping another one, eventually a fight will ensue.
- The one who wins will keep its territory, while the other will die and lose its.



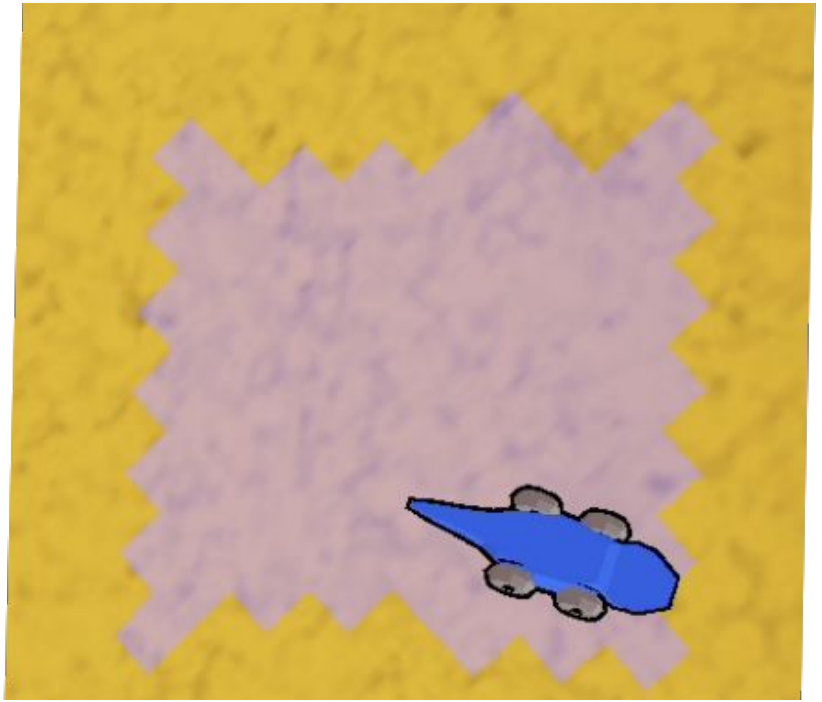
Modelling behaviours: fighting ground

- Males will enter a fight when trying to steal the territory of each other or when a sneaker is found by the owner of the territory.
- The winner is decided by the size and morph of the lizard.
- Orange males are the most likely to win.
- The winner will return to its territory (if it has one), the loser will die.



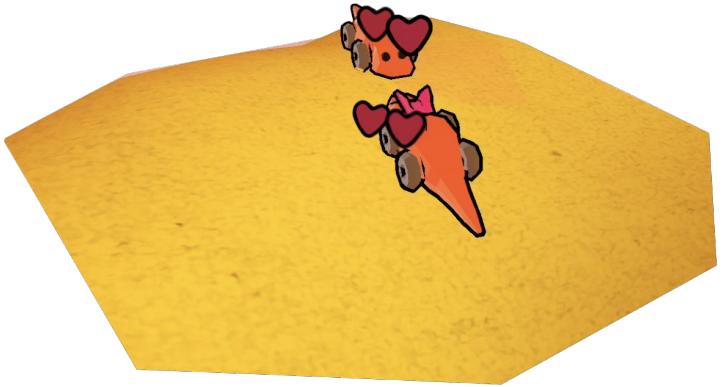
Modelling behaviours: dying

- When a male dies, the territory is erased, unless a yellow lizard takes the place of the owner (aka bluecoming).
- When a territory is erased, all females in that territory will search for a new one.



Modelling behaviours: the mysteries of love

- Females can meet males by entering a territory or, when already in one, by encountering the owner or a yellow male.
- They will decide to mate depending on the morph and size of the male.
- If the mating goes through, a child will be born shortly after. Otherwise, the female rejects the male, breaking its heart in the process.



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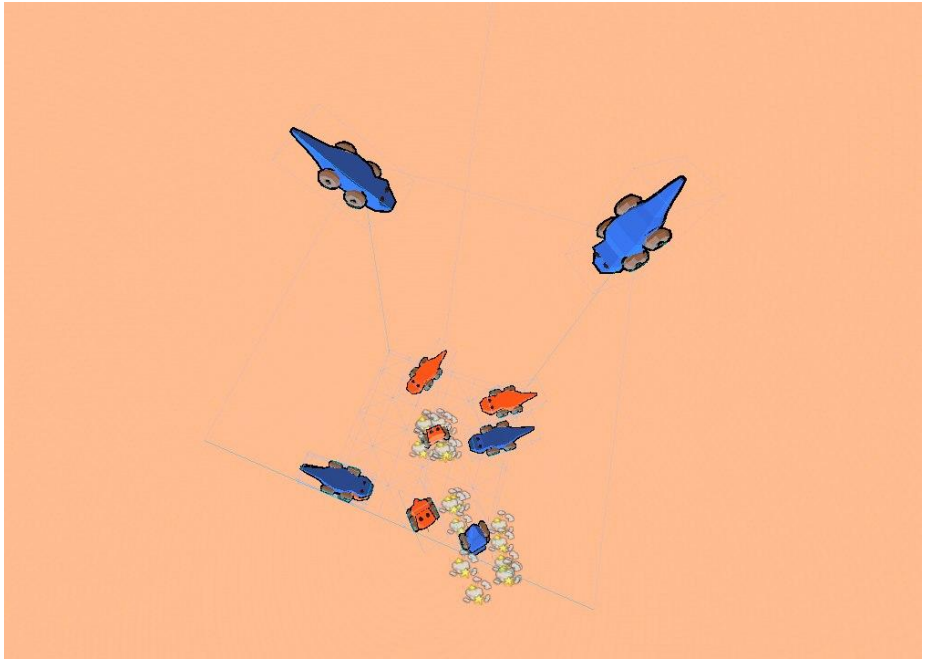
Conclusions

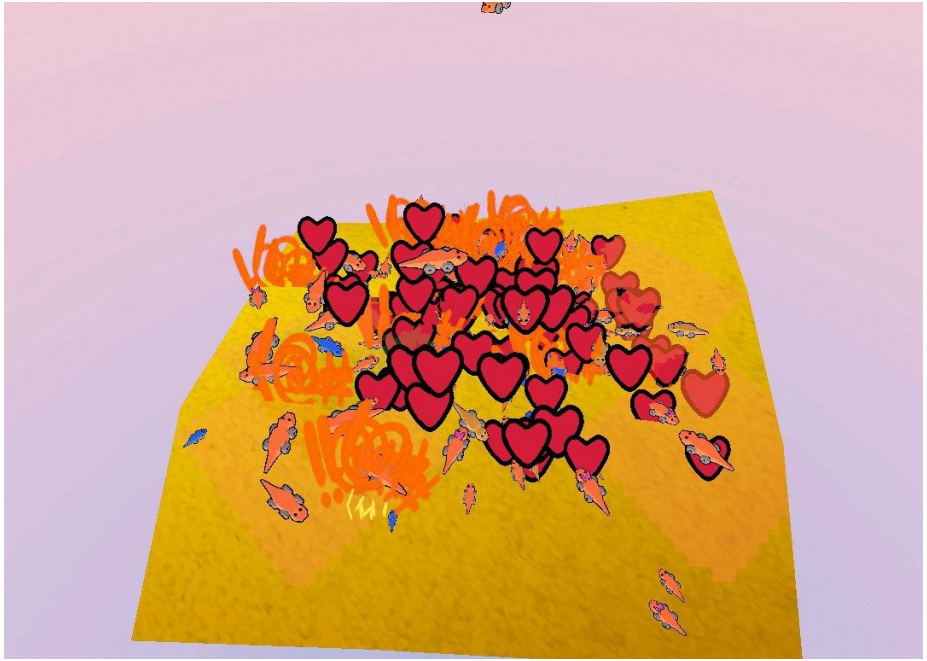
- We have modeled the rock-paper-scissors mating behavior of the peculiar *“Uta stansburiana”* lizard species.
- To implement our model we have used the Godot Engine which allowed us to model our population in a 3D environment.
- By observing simulations of our model we have seen the typical rock-paper-scissors population oscillating behavior between the various morphs.

Thank you for your attention!

Bloopers

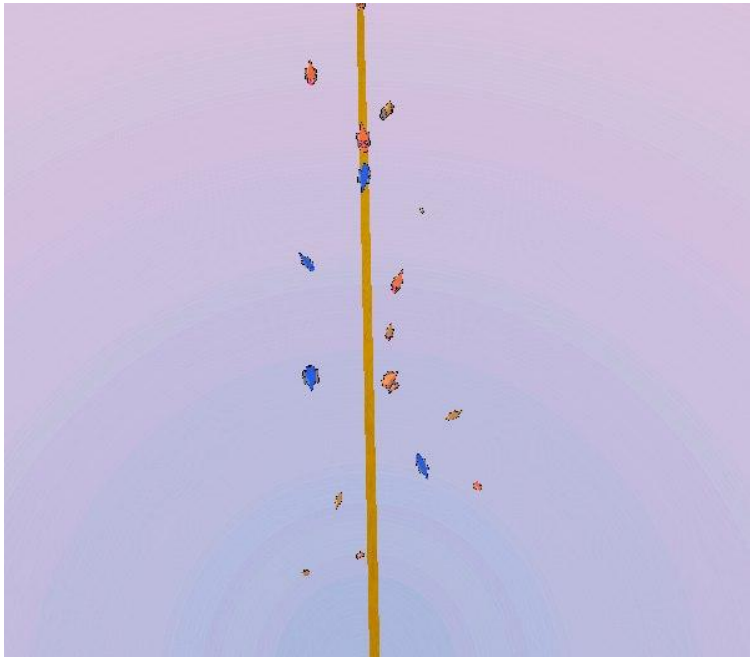


Fighting beyond boundaries

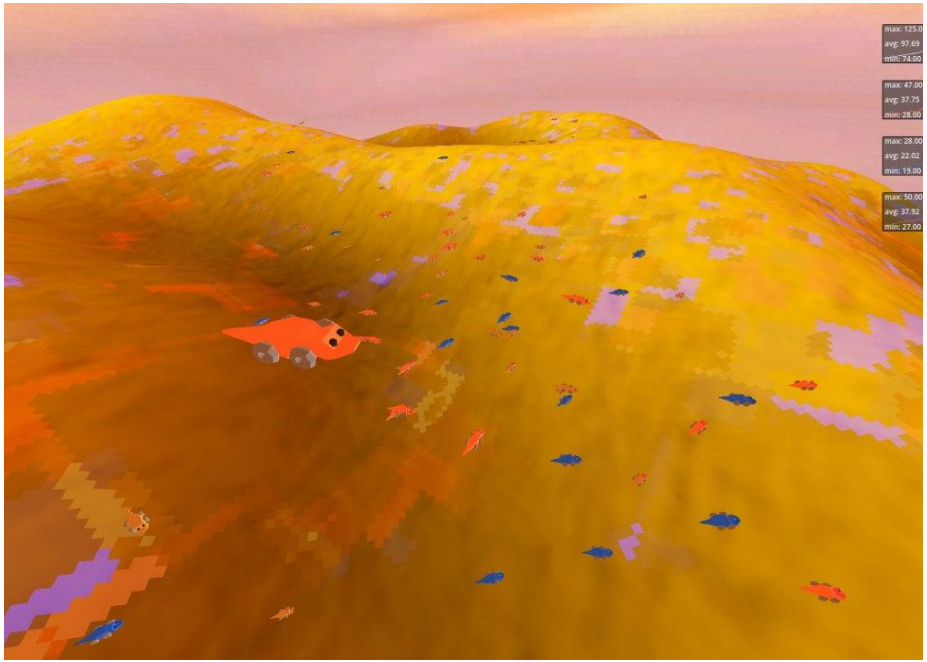


Love and War

Bloopers

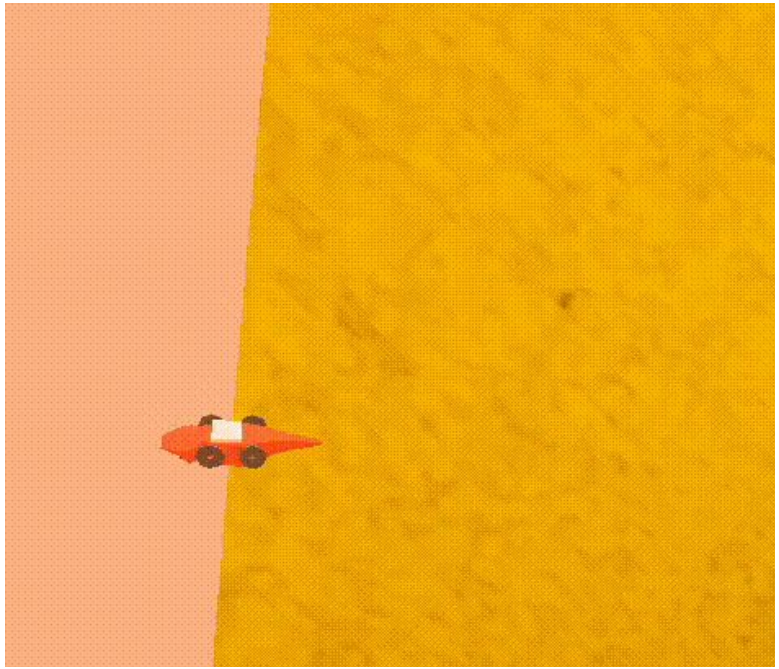


1D Desert



Attack of the giant lizard

Bloopers



You spin me round

Carnival in May