

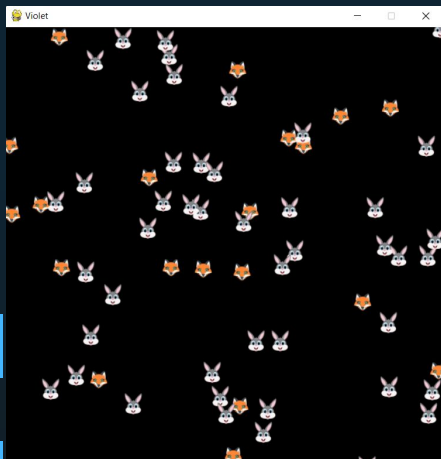
Collective Intelligence

Assignment 2: Fox-Rabbit competition modelling

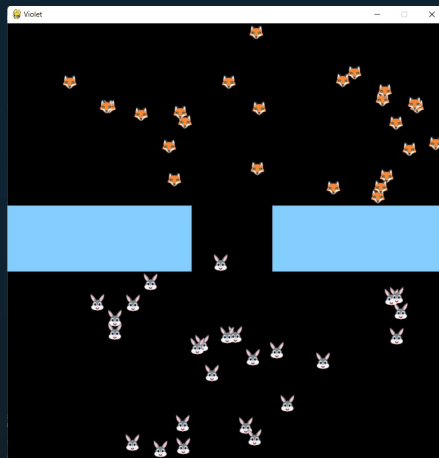
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THE TASK

Create a predator-prey (fox vs. rabbit) system based on the Lotka-Volterra.
Perform a comparative study.



2 populations, no
extras



Obstacle added to
separate populations



Energy concept added
to Prey

INTRODUCTION

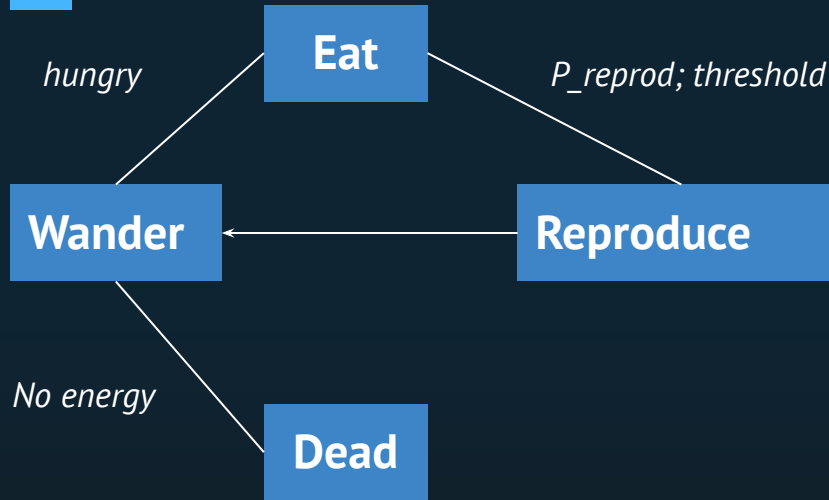
PURPOSE OF THE SIMULATION:

- **Visualize data**
- **A way to study behavioural patterns and environmental effects**

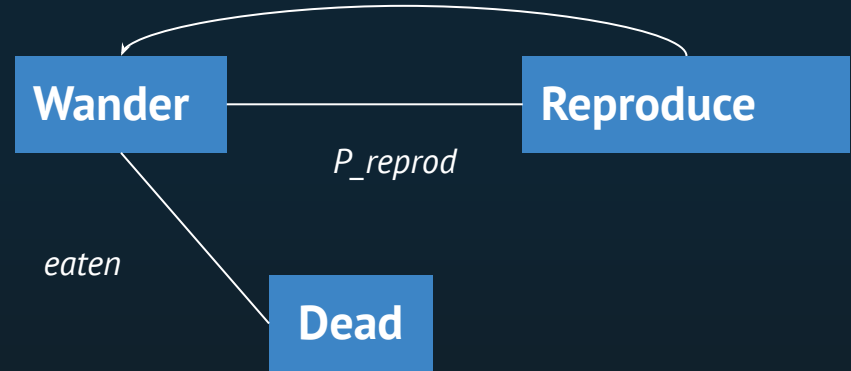
QUESTIONS ANSWERED WITH THE SIMULATION:

- **How does the spatial behaviour of agents affect the population growth of two different species in a predator?**
- **What type of parameter settings can be used to extract different behaviours from the agents?**

METHODOLOGY



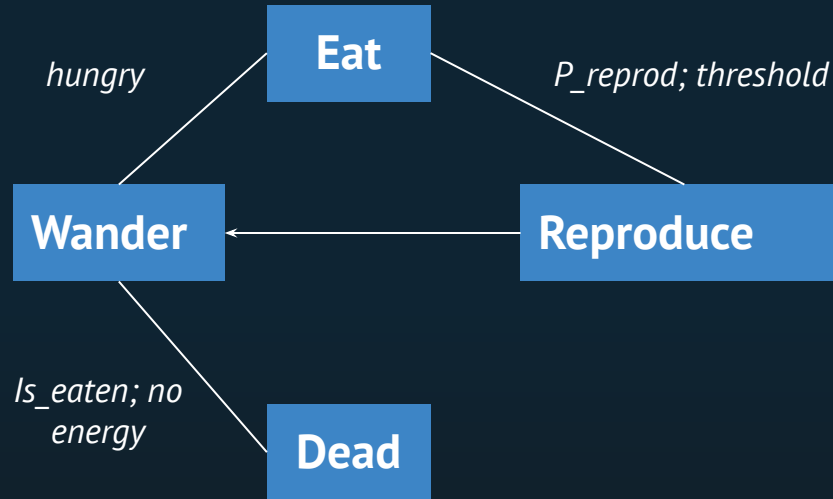
Fox



Rabbit

[1] Predator-Prey Models, Stephanie Forrest, Dept. of Computer Science, Univ., of New Mexico, Albuquerque, NM

METHODOLOGY



Fox

Rabbit

Probabilistic approach

- Reproduction probability for foxes
 - Energy level and threshold →
uniform($1/\text{energy}$) and threshold
- Set probability for rabbits

Parameters

radius	10, 15, 20
Populations ratio (r:f)	20:20, 20:30, 25:50, 40:40
movement_speed	0.5, 1, 1.5, 2
start_energy (f)*	15, 20, 30, 40, 50
energy_gain (f)	0.1, 0.25, 0.5, 1, 2
energy_decay (f)/s	0.5, 1, 2, 5
reprod_threshold (f)	5, 6, 6.5, 7, 10, 15
reprod_prob (r)	0.2, 0.3, 0.4, 0.5, 0.6, 0.75
reprod_time (r)	1s, 2s, 3s, 4s, 5s, 10s

* f = foxes; r = rabbits

Parameters

radius	15
Populations ratio (r:f)	20:20
movement_speed	1.5
start_energy (f)*	20
energy_gain (f)	0.25
energy_decay (f)/s	1
reprod_threshold (f)	10
reprod_prob (r)	0.5
reprod_time (r)	5s

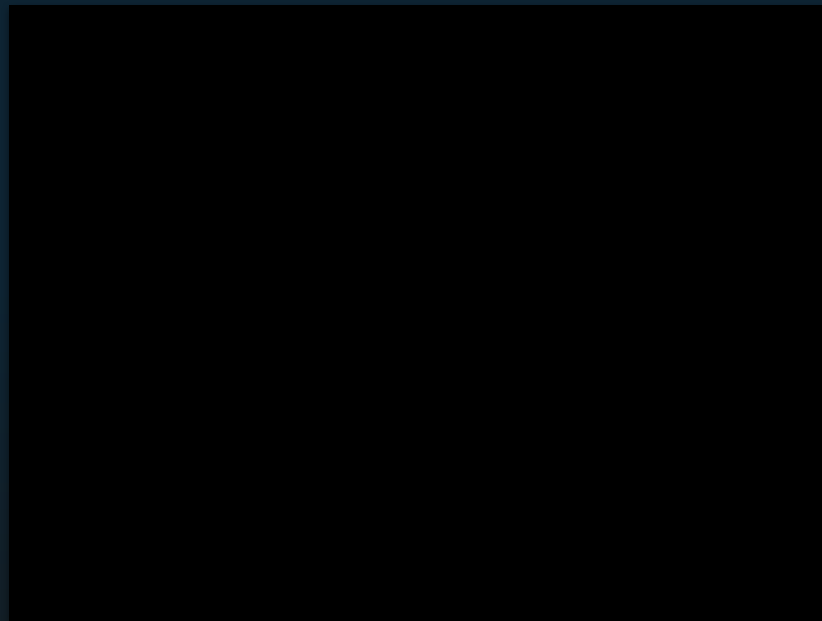
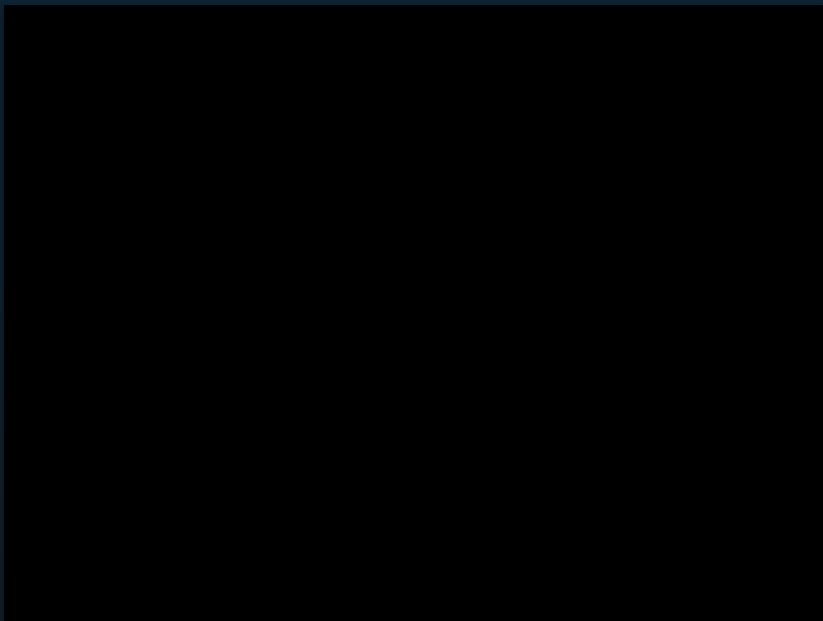
* f = foxes; r = rabbits



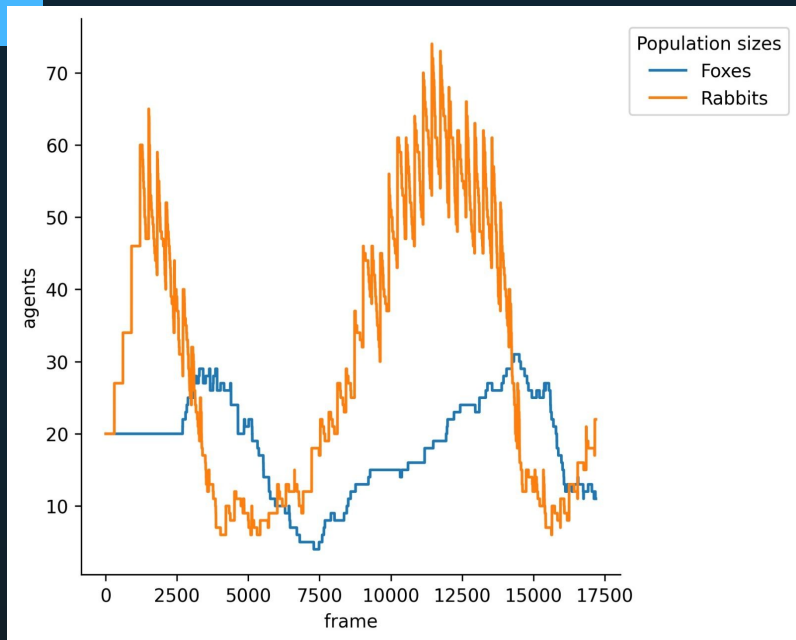
Results

Result Analysis

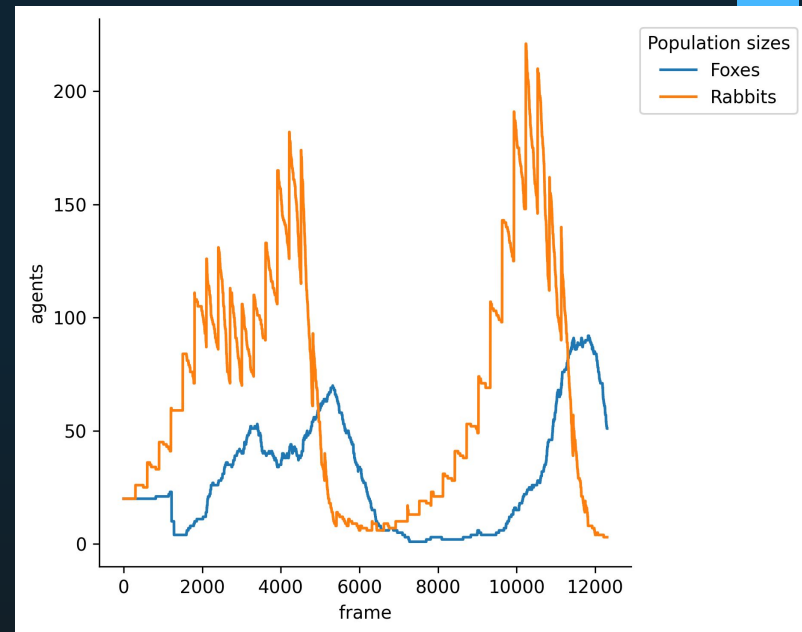
Demos



Population sizes

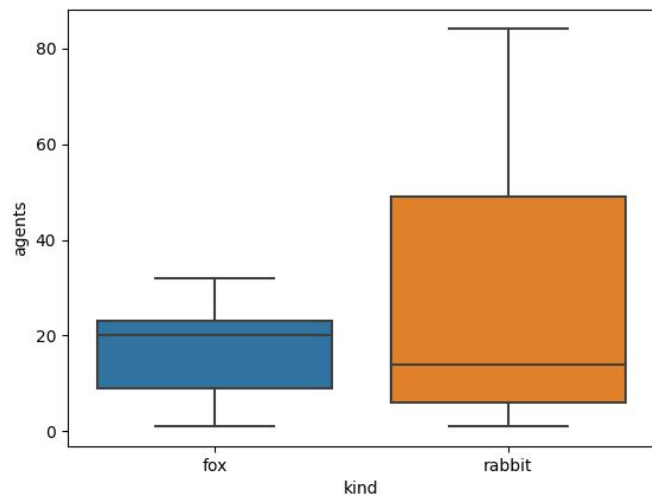


No obstacle

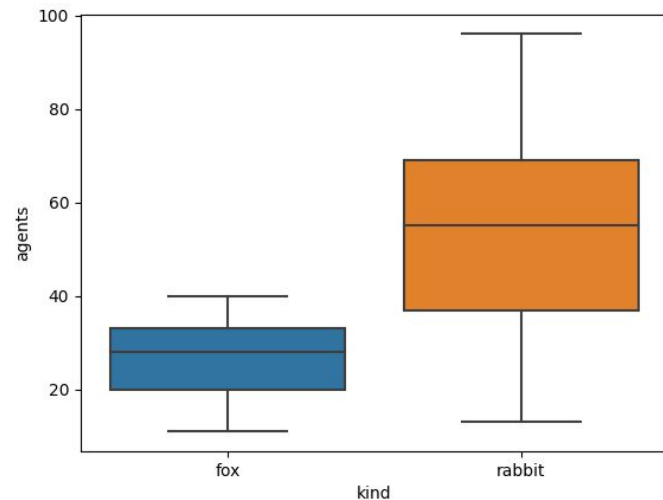


Obstacle

Range of # Agents

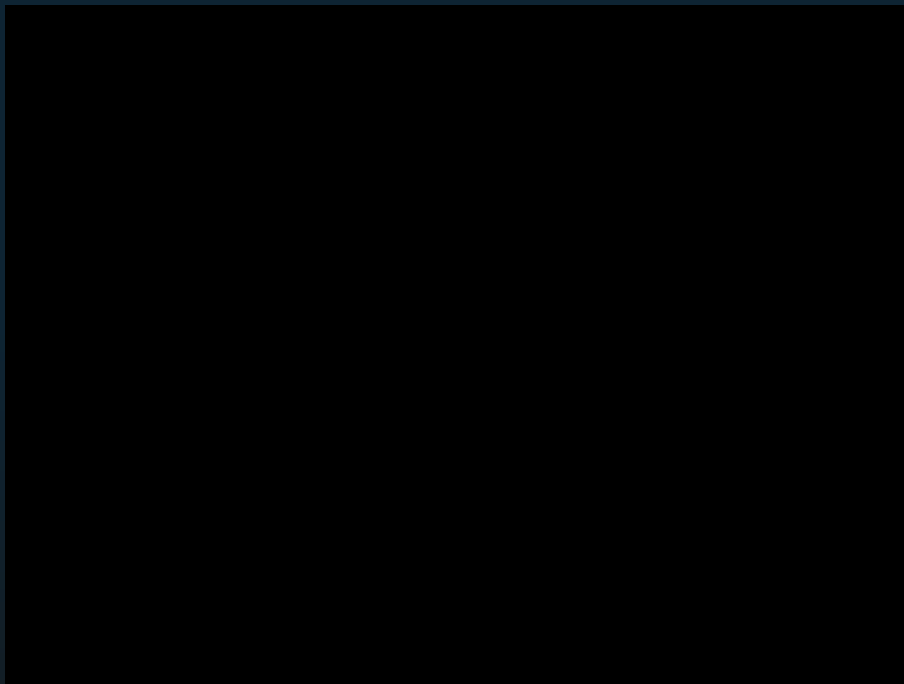


No Obstacles



With Obstacles

Demos



Stats

H0: The avg # of agents is equal between the two groups

HA: The avg # of agents is not equal between the two groups

No Obstacles

`WilcoxonResult(statistic=25535114.5, pvalue=6.033989331855553e-183)`

With Obstacles

`WilcoxonResult(statistic=1255493.0, pvalue=1.7107984402765896e-133)`

Expectations

- Populations alternating in size
- Constant interactions
- Obstacle causing early extinction
- Graphs in line with Lotka Volterra
- Small number of outliers in stats

Results

- Extinction occurs
 - tuning and conditions on reprod
- Patterns as expected
- Spatial interference by object
- No clear outliers

Conclusion



- Agent based Simulation of competitive behaviours observed in nature.
- Different implementation and approaches.

Conclusion



- Conclusion of the results found and its implications
- Further research
 - Movement influence
 - Reproduction and aging
 - Longer simulations

Skills Learnt



Creativity to implement
our own ideas



Parameter
Tuning and Evaluation

Sources

[2] Karsai, I., Montano, E., & Schmickl, T. (2016). Bottom-up ecology. Letters in Biomathematics, 3(1), 161-180.

[3] Bousquet, F., & Le Page, C. (2004). Multi-agent simulations and ecosystem management: a review. Ecological modelling, 176(3-4), 313-332.

Thank you!