

Norwegian University of Life Sciences



Modelling the Ecosystem of Rossumøya



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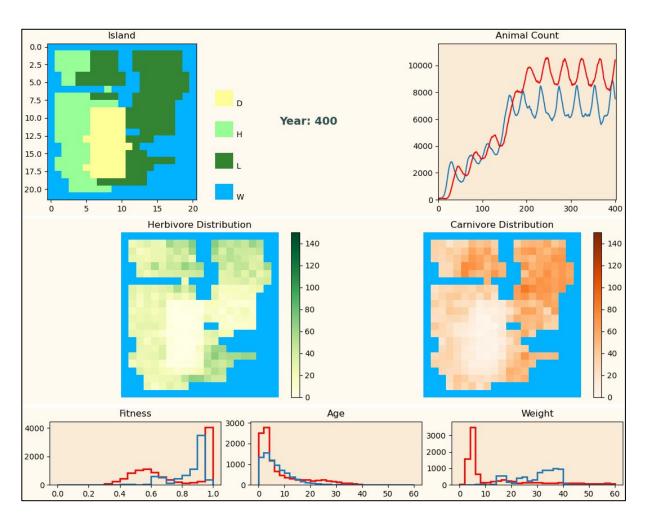
Agenda

- The project
- Components
- Solving issues
- Code quality and style
- Testing
- Documentation
- Performance
- Results and examples of output
- Add-ons
- Further improvements
- Questions and discussion

The project

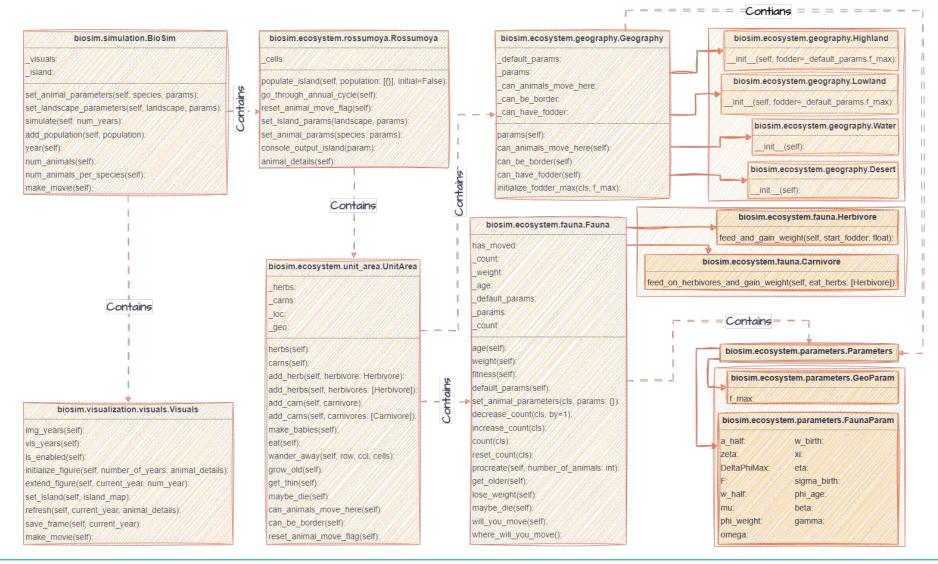


- The study of the stability of the ecosystem on Rossumøya
- Long term goal: preserve
 Rossumøya as a nature park for future generations
- Investigate if herbivores and carnivores can survive (together) in the long term



Components





Solving issues



Why:

- Easier debugging
- Discovering issues more efficiently

How:

- __str__ to classes
- logging vs printing

```
src/biosim/simulation.py
        import logging
        import random
        import sys
        from biosim.model.Fauna import Herbivore
        from biosim.model.Rossumoya import Rossumoya
  11
        logging.basicConfig(filename=f'{sys.path[1]}/logs/biosim.log',
                            format='%(message)s',
                            level=logging.DEBUG)
        class BioSim:
                for year in range(1, num_years):
                    if self._log_file is not None:
                        writer.writerow([year, Herbivore.count()])
                    print(f"Year:{year}")
                    logging.debug(f"Year:{year}")
```

```
Evaluate
Expression:
self
                 Use Ctrl+Shift+Enter to add to Watche
Result:
 H | H | H | H | H | L.H200.C50 | L | L
 w | w | w | h | h | h |
 | H | H | W
```

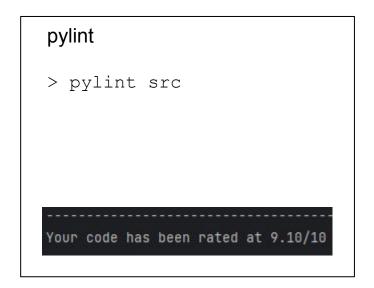
```
     = carn = {Carnivore} C-A1-W20-F1.0-M0
     = herb = {Herbivore} H-A2-W13-F0.57-M0
```

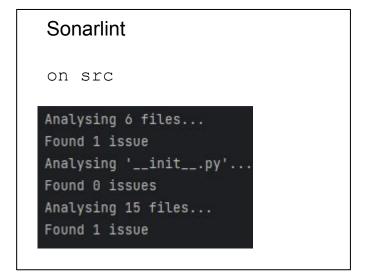
Code quality and style



Code quality was checked with:

flake8 (via CI and manually): > flake8 src tests examples 65 \$ flake8 src tests examples 67 Saving cache for successful job





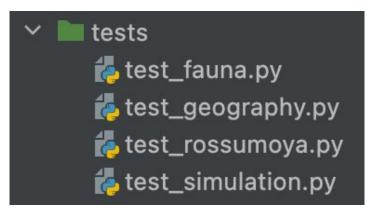
- Code optimized with sourcery.ai
- Code is easy to understand and maintainable
- Followed OOPS

Testing



- All tests passed
 - Including reference_tests and our own
- A total of 72 tests, covering 84% of lines
- Important errors were discovered during the making of the tests

```
Src 88% files, 84% lines covered
biosim 88% files, 84% lines covered
covered
init__.py
fauna.py 79% lines covered
geography.py 96% lines covered
parameters.py 100% lines covered
rossumoya.py 89% lines covered
unit_area.py 75% lines covered
unit_area.py 75% lines covered
init__.py
visualization 100% files, 87% lines covered
init__.py
visuals.py 87% lines covered
init__.py 100% lines covered
simulation.py 77% lines covered
```



Documentation



Docs » Welcome to BioSim's documentation!

Welcome to BioSim's documentation!

This is a simulation on

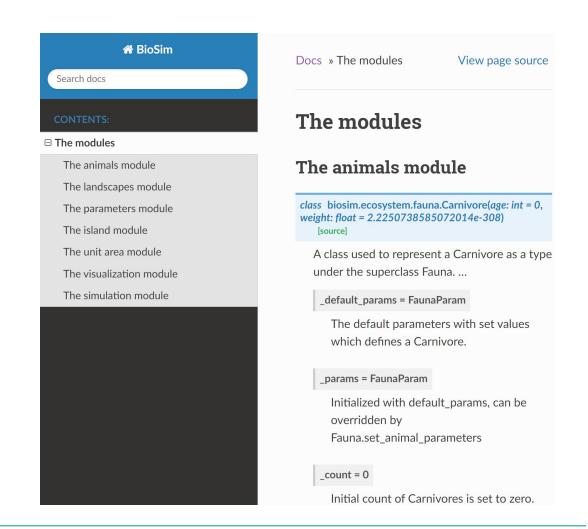
The island Rossumøya

Its several geographies

And its animals within

Contents:

- The modules
 - The animals module
 - The landscapes module
 - The parameters module
 - The island module
 - The unit area module
 - The visualization module
 - The simulation module



Performance

- Fitness calculation is not optimized enough
- Used **numba** for faster mathematical calculations. (~4 times for fitness)

Improvements:

- Parallel processing for each cell for some operations.
- Simulations can be run in parallel.
- Use dict {} instead of 2d array[[]] ?

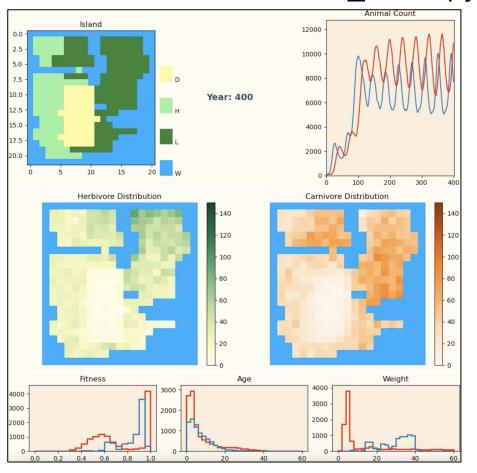




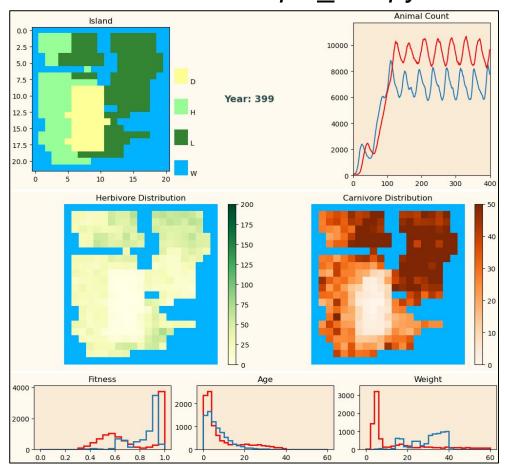
Results and examples of output



End-result of simulation_visual.py



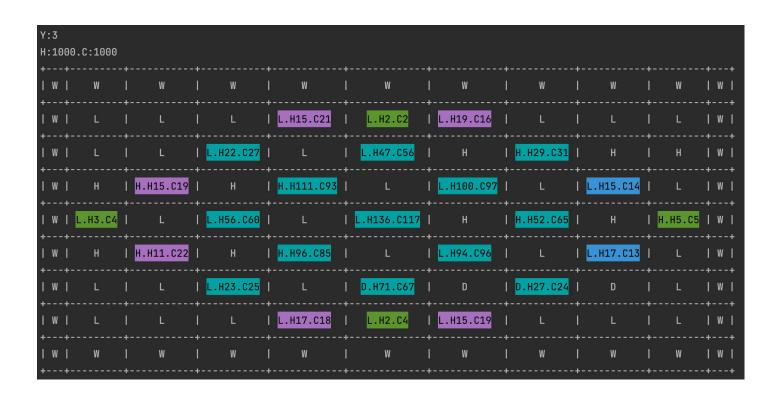
End-result of sample_sim.py



Add-ons



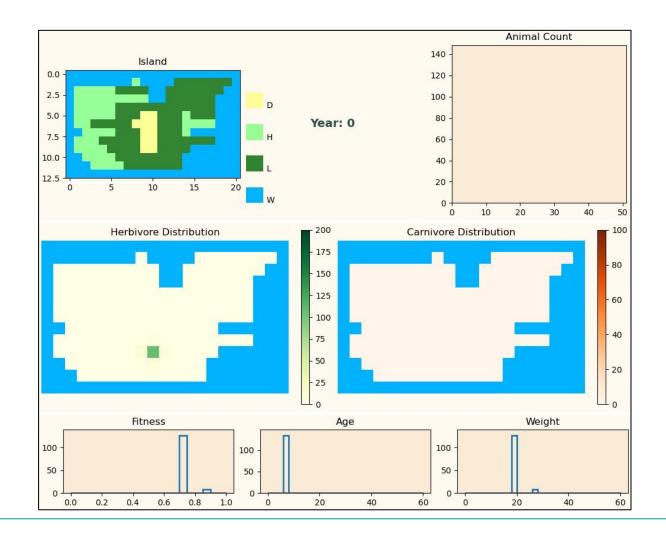
- Colorful console output of a rough map
- Easy to observe the distribution of the population on the island



Add-ons



- Heatmap has water highlighted in blue
- The visualization of the dynamics is more realistic



Further improvement areas



- Improve performance
- More test coverage
- More robust
 - data validation
 - persist simulation state to storage
- More complex environment
 - more steps in annual cycle
 - more parameters
- Aquatic animals ?
- Interactive plots



Questions and discussion

