



24th Sep 2021

# Agent Based Modeling with Python MESA

---

Lorenzo Ghio

*lorenzo.ghio@unitn.it*

- Agent-based modeling (ABM) is a way to simulate the behaviors and interactions of autonomous entities over time.
- Agents:
  - have properties and behaviors.
  - interacts with and influence each other.
  - learn from their experiences.
  - adapt their behaviors to they are better suited to their environment(s).
- Example: SIR models perfect for ABM.

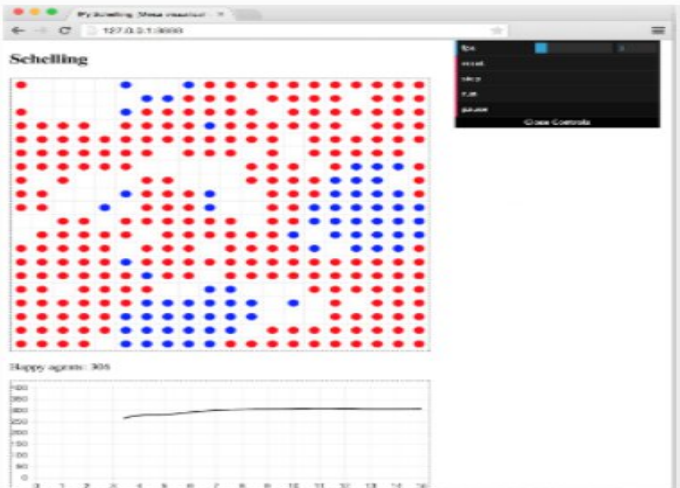
- Agent-based modeling has been used successfully to model complex adaptive systems.
- Biology, Supply chains, economics, military planning, consumer market analysis, **Distributed Systems/Algorithms!**
- ABM tools
  - StarLogo, NetLogo, Swarm, MASON, EcoLab, GAMA, Repast...
  - **MESA**

Kazil, Jackie, David Masad, and Andrew Crooks. "Utilizing **Python** for **Agent-Based Modeling**: The **Mesa** Framework." *International Conference on Social Computing, Behavioral-Cultural Modeling and Prediction and Behavior Representation in Modeling and Simulation*. Springer, Cham, 2020.

# Mesa: Agent-based modeling in Python

**Mesa** is an Apache2 licensed agent-based modeling (or ABM) framework in Python.

It allows users to quickly create agent-based models using built-in core components (such as spatial grids and agent schedulers) or customized implementations; visualize them using a browser-based interface; and analyze their results using Python's data analysis tools. Its goal is to be the Python 3-based counterpart to NetLogo, Repast, or MASON.



Now, we set up the batch run, with a dictionary of fixed and changing parameters. Let's hold everything fixed except for Homophily.

```
In [13]: parameters = {"height": 10, "width": 10, "density": 0.8, "minority_pc": 0.2,
                      "homophily": range(1,9)}

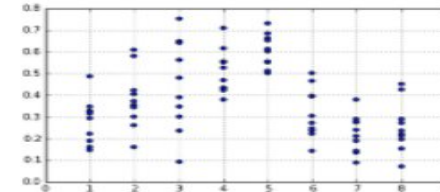
In [14]: model_reporters = {"Segregated_Agents": get_segregation}

In [24]: param_sweep = BatchRunner(SchellingModel, parameters, iterations=10,
                                   max_steps=200,
                                   model_reporters=model_reporters)

In [25]: param_sweep.run_all()

In [26]: df = param_sweep.get_model_vars_dataframe()

In [28]: plt.scatter(df.homophily, df.Segregated_Agents)
         plt.grid(True)
```



Above: A Mesa implementation of the Schelling segregation model, being visualized in a browser window and analyzed in an IPython notebook.

## Getting started quickly

`pip install mesa`

- Following tutorials together in class
  - [Mesa Introductory Tutorial](#)
  - [Mesa Advanced Tutorial](#)

# Questions?

