

Introduction to Agent-Based Modeling with Python

Agent-Based Modeling (ABM) is a powerful technique used to simulate interactions of autonomous agents to assess their effects on the system as a whole. In this exercise, you will create a basic ABM using Python, where agents move randomly in a 2D space and interact with their environment.

1. Objectives:

- Understand the basic concepts of Agent-Based Modeling.
- Implement a simple ABM in Python.
- Visualize agent movement and interaction.

2. Problem Description:

You are tasked with creating a simple Agent-Based Model in Python. In this model:

- There are 50 agents randomly distributed on a 2D grid of size 100x100.
- Agents move randomly (up, down, left, right) at each time step.
- When two agents are within a distance of 1 unit, they "interact" by stopping their movement.

Instructions:

1. Set up the 2D grid and the initial positions of the agents.
2. Program the agents to move randomly within the grid.
3. Implement a simple rule where agents within a distance of 1 unit stop moving.
4. Simulate this system over 100 time steps.

3. Hints:

- You can represent the agents as a list of coordinates (x, y).
- To calculate the distance between two agents, use the Euclidean distance formula:
$$\text{distance} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}.$$
- To visualize the agents, you can use matplotlib's scatter plot.

Good luck and enjoy the learning process!