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Reminder

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Agent Based Modeling

(Mesa Tutorial NSIP 2024)
efrén cruz cortés

What is an agent based model?

A model of a complex system focusing on:

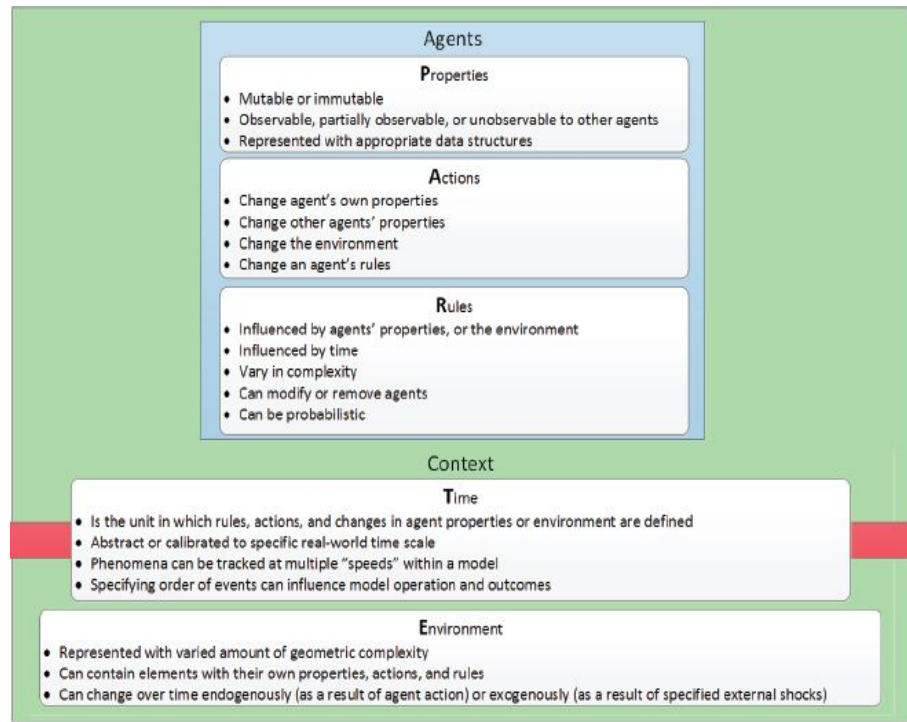**Agents** and their **interactions** in **time** and **space**.

Conceptual Framework - PARTE

Agents

- **P**roperties
- **A**ctions
- **R**ules

Context

- **T**ime
- **E**nvironment

Agents

Properties
- Mutable or immutable
- Observable, partially observable, or unobservable to other agents
- Represented with appropriate data structures

Actions
- Change agent's own properties
- Change other agents' properties
- Change the environment
- Change an agent's rules

Rules
- Influenced by agents' properties, or the environment
- Influenced by time
- Vary in complexity
- Can modify or remove agents
- Can be probabilistic

Context

Time
- Is the unit in which rules, actions, and changes in agent properties or environment are defined
- Abstract or calibrated to specific real-world time scale
- Phenomena can be tracked at multiple "speeds" within a model
- Specifying order of events can influence model operation and outcomes

Environment
- Represented with varied amount of geometric complexity
- Can contain elements with their own properties, actions, and rules
- Can change over time endogenously (as a result of agent action) or exogenously (as a result of specified external shocks)

RA Hammond 2015, "Considerations and Best Practices in Agent-Based Modeling to Inform Policy

Notes

Terminology

- The collection of agents + context is often called *the system*.
- When coding up an ABM, we usually assume there is some all-knowing *observer* that gathers information about the system.

Background

- For this tutorial, I'll assume you know a little bit of Object Oriented Programming (we had an NSIP on that [here](#)). In particular, we will work with **classes**.
- This is not an ABM tutorial, but a Mesa tutorial. For more info on ABM, see resources at the end of tutorial file.
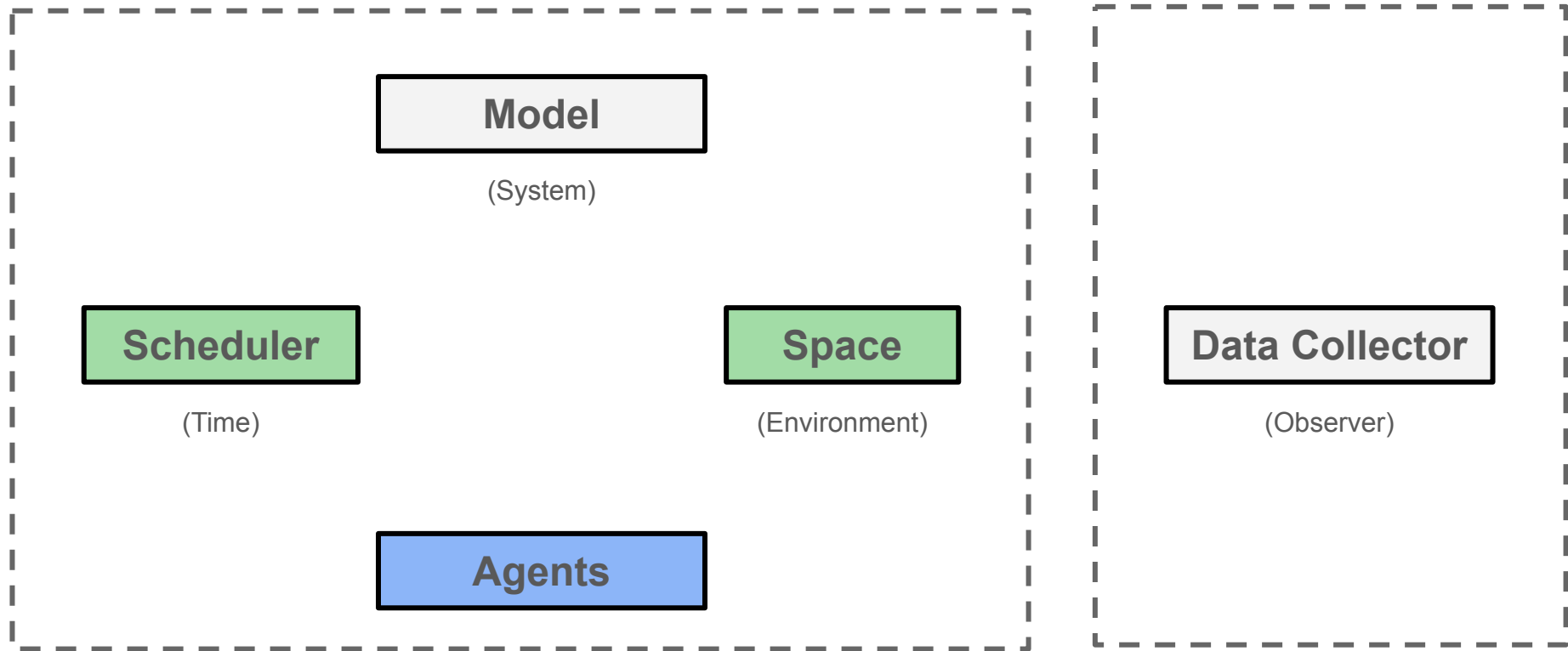
Mesa

Mesa is a python package for agent-based modeling.

It is in its initial stages, so it may evolve rapidly.

It makes your life easier especially when it comes to dealing with time and environment.

Coding Framework - Mesa

Model

(System)

Scheduler

(Time)

Space

(Environment)

Agents

Data Collector

(Observer)

Batch Run (Parameter Sweep)

Parameter	Iteration	Model Step	Agent Data
Θ_1	Iteration 1	t_1	$A_1, A_2, A_3, \ldots, A_N$
		…	
		t_f	
	Iteration 2	…	…
	…	…	…
Θ_2	Iteration 1	…	…
	Iteration 2		
	…		
. . .	…	…	…

Coding Framework - Mesa