Scheduling Model Behavior

EES 4760/5760

Agent-Based & Individual-Based Computational Modeling

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Models to Download

https://ees4760.jgilligan.org/models/class_17/Mousetrap_Ch14.nlogo

https://ees4760.jgilligan.org/models/class_17/Mousetrap_Ch14_v2.nlogo

https://ees4760.jgilligan.org/models/class_23/Ch_23_4_breeding_synchrony.nlogo

Modeling for Actionable Research

Modeling for Actionable Research

- Using agent-based models of socio-environmental systems to inform planners, public, government decision-makers
  - Disaster planning
  - Conservation and sustainability
- Grand challenges:
  - Data: Combining different kinds of data, new sources of data, managing big data, …
  - Challenges of research disciplines: Using models to integrate different kinds of knowledge. Challenge of aligning different ways of thinking.
  - Predictions and Uncertainty: Can models built on today's conditions anticipate very different future conditions? How to plan for uncertain future? How to communicate with public about models?
  - Making models useful: What do non-experts want to know? Results of models, or modeling process? Participatory and interactive models. Tools to let non-programmers develop models.
  - Challenges of future technology: Modeling tens or hundreds of millions of people. Integrating people into big models of climate, rivers, cities, etc.

Scheduling Actions:

- Representing time:
  - Discrete (`tick`)
  - Continuous (`tick-advance`)
- Execution order
  - Synchronous
  - Asynchronous
    - Random order
    - Determined order

Repeating actions

- `repeat` repeats a certain number of times

```
repeat 5 [ wander ]
```

or

```
repeat random count turtles [ wander ]
```

- `while` repeats as long as a condition is true

```
while not any? turtles-here [ wander ]
```

- `loop` repeats forever (until `stop` or `report`)

```
loop [
  wander
  if any? turtles-here [ stop ]
]
```

Discrete vs. continuous time

- Almost all models use discrete time:
  - `tick` advances tick counter by 1.
  - `ticks` is always an integer.
- Continuous time
  - `tick-advance 2.3`
- Things to think about:
  - When to tick?

```
to go
  ask patches [ do-patch-stuff ]
  ask turtles [ do-turtle-stuff ]

  tick
  if ticks > run-duration [stop]
end
```

```
to go
  tick
  if ticks > run-duration [stop]

  ask patches [ do-patch-stuff ]
  ask turtles [ do-turtle-stuff ]
end
```

Order of execution

- `ask`: Asks turtles in a random order.

```
ask turtles [do-sales]
```

- Suppose we wanted bigger turtles to act before the smaller ones?

```
foreach sort-on [(- size)] turtles
[
  next-turtle -> ask next-turtle [do-sales]
]
```

Concurrent execution

- `ask-concurrent` (**not recommended**)

This is a relic from older versions and can create problems if you use it.

Synchronous vs. asynchronous updating

- What is the difference?
- When would you want to use one or the other?
  - Business investor model?
  - Telemarketer model?
- How would you do *asynchronous* updating?
- How would you do *synchronous* updating?
  - Hidden state-variables (turtle can't see other turtle's hidden variables)
  - Two ways:
    1. Break submodel into two parts:
       1. Turtles have sense and update hidden state-variables that others can't sense
       2. Update environment (including state-variables that others can sense)
    2. Make shadow copy of all state variables:
       1. Sensing sees originals, updates change shadow-copies
       2. Update the original (`set original shadow-copy`)
- What advantages or disadvantages does *synchronous updating* have versys *asynchronous*?

Mousetrap model

Mousetrap model

https://youtu.be/XIvHd76EdQ4

Mousetrap model

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- Play with models
- Compare continuous updating with updating on ticks

Breeding Synchrony Model

Breeding Synchrony Model

https://ees4760.jgilligan.org/models/class_23/Ch_23_4_breeding_synchrony.nlogo

- Colonies of sea birds (up to several thousand) often exhibit synchronized breeding:
  - Birds with very different characteristics & histories lay eggs at the same time
    - Different stored energy, different arrival times, …
- Different colonies in nearby areas lay eggs at different times
  - So environemntal factors (e.g., phase of moon) aren’t explanation
- Why?

Breeding Synchrony Model

- Is stress the answer?
  - “Stressful neighborhoods”:
    - If other birds are still competing for mates, nesting material, it’s dangerous to lay eggs.
    - Hypothesis: Birds wait until neighborhood is fairly calm to lay eggs.

Breeding Synchrony Model

- Model:
  - Birds' activities cause stress in neighbors
  - Key variables:
    - **OSL**: a bird's own stress level,
    - **mean NSL**: average of neighbors' stress levels,
    - **NR** (0–1): neighborhood relevance: how much a bird's stress is influenced by its neighbors,
    - **SD** = 10: stress decay rate: How quickly a bird loses stress without external stimulus.

$$\text{OSL}_t = (1 - \text{NR})\text{OSL}_{t-1} + (\text{NR} \times \text{mean NSL}_{t-1}) - \text{SD}$$

- Birds start out with random OSL between 100 and 300.
- Birds lay eggs when $\text{OSL} \leq 10$.
- Synchronous updating:
  - All birds compute OSL_t using stress levels at $t-1$, then they all update together
- How does breeding synchrony depend on NR?