An Introduction to Agent-Based Modeling

Unit 2: Building a Simple Model

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NetLogo

• Go through the tutorials on the NetLogo website
• Three Tabs
  • Interface
  • Info
  • Code
Model Settings

- World Size
- Wrapping
Running A Model

- Setup
- Go
- Speed Slider
Interface Elements

- Button
- Slider
- Chooser
- Switch
- Input
- Monitor
- Plot
- Output
- Note
Info Tab

• What is It?
• How It Works
• How to Use It
• Thing to Notice
• Things to Try
• Extending the Model
• NetLogo Features
• Related Models
• Credits and References
Turtle Relevant Commands

• create-turtles (crt)
• ask
• forward (fd), backward (bk)
• left (lt), right (rt)
• repeat
• color, size, xcor, ycor
• pen-down (pd), pen-up (pu)
• clear-all (ca)
• monitor
• die
Patches

• Inspector
• Patch Color is pcolor
• Turtles can directly access patches
• Relevant Commands
  • setxy, facexy
  • random-xcor (pxcor) and random-ycor (pycor)
Links

• Creating - create-link(s)-with / to /from
• Links have their own properties
Code Tab

• creating a procedure
  • to and end
• finding procedures
• indentation
• checking code
Saving and Documenting Your Code

• Save Often
• Save major changes with a new name
• Edit the Info Tab at the same time
Properties

• global properties
  • globals
• turtle properties
  • turtles-own
Setup and Go

• setup and go are not required, but are NetLogo style

• Other commands:
  • tick
  • if, ifelse
  • repeat
  • while
Heroes and Cowards

• Used by the Fratelli Group in the 1980s and 1990s and presented at a conference called Embracing Complexity in 1999
• Normally, to play the game you need a group of people, but we will explore it in simulation, several exist already
• Each person chooses an “enemy” and a “friend”
• Two stages to the game:
  • Cowards - place your friend between you and the enemy
  • Heroes - place yourself between your friend and the enemy

from Bonabeau et al., 2003
The *setup* procedure

to setup
  clear-all
  ask patches [ set pcolor white ] ;; blank background
  create-turtles 100 [
    setxy random-xcor random-ycor
    ;; set the turtle personalities based on a chooser
    if (personalities = "cowards") [ set color blue ]
    if (personalities = "heroes") [ set color red ]
    ;; choose friend and enemy targets
    set friend one-of other turtles
    set enemy one-of other turtles
  ]
  reset-ticks
end
The *go* procedure

to go

    ask turtles [
        if (color = blue) [ act-cowardly ]
        if (color = red) [ act-bravely ]
    ]

end
**act-bravely and act-cowardly**

to act-bravely

;; move toward the midpoint of your friend and enemy
facexy \([xcor] \) of friend + \([xcor] \) of enemy) / 2

\((\[ycor]\) of friend + \([ycor]\) of enemy) / 2

fd 0.1

end

to act-cowardly

;; move toward the midpoint of your friend and enemy
facexy \([xcor]\) of friend + \((\[xcor]\) of friend - \([xcor]\) of enemy)

\([ycor]\) of friend + \((\[ycor]\) of friend - \([ycor]\) of enemy)

fd 0.1

end
Extending the Model

• What about mixed types?

if (personalities = “mixed”) [ set color one-of [ red blue ] ]
Turtle Monitors and Links

• Inspect a turtle
• create-link-with friend [set color green]
• create-link-with enemy [set color red]
Documenting the Model

Initialize:
- Create NUMBER turtles, where NUMBER is set by a slider in the interface
- Each turtle moves to a random location on the screen
- If the PERSONALITIES slider is set to “brave”, each turtle turns red
- If the PERSONALITIES slider is set to “cowardly”, each turtle turns blue
- If the PERSONALITIES slider is set to “mixed”, each turtle “flips a coin” and depending on the outcome, it turns red or blue
- Each turtle picks one other turtle as a friend
- Each turtle picks one other turtle as an enemy
- The NetLogo clock is started

At each tick:
- Each turtle asks itself “Am I red?” If yes, then I will act bravely by moving a step towards a location between my friend and my enemy
- Each turtle asks itself “Am I blue?” If yes, then I will act cowardly by moving a step towards a location that puts my friend between my enemy and me
Random Number Generators (RNG)

• RNGs - Create pseudo-random numbers
• Use a “seed” to create “random numbers” deterministically

random-seed 188
show random 100
show random 100
show random 100
random-seed 188
show random 100
show random 100
show random 100
Discovering Patterns

Preset configurations – Press button, then GO.

- dot
- frozen
- slinky
- spiral
- slinky 2
- spiral 2
- yo-yo
- wandering flock
- generally cool one that eventually stops
Unit 2 Wrap-Up

- Introduction to NetLogo
- Turtles, Patches, and Links
- The Code Tab
- Properties
- Heroes and Cowards
- Building the Model
- Extending the Model
- Documentation
- Random Numbers

- Guest Video by Marco Janssen at Arizona State University - Empirical ABM
- Unit 2 Test
- Slides
- Next Week: Unit 3 - Extending Models
Thank You