Agent Based Modelling

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- Models usually consist of a “world-state” variable that records attributes of the environment, and a list of agents each with their own individual attributes.
- Each agent usually has a “step” function that allows the agent to interact with the environment, and we model time discretely by repeatedly invoking the step function for each of our agents

Simple Agent Based Model

Please refer to SimpleMoneyModel.ipynb file!

Uses of ABM - Emergent Behavior

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- Other examples of this include modelling bird-flocking, rebellions, etc.

Complex Examples

http://netlogoweb.org/launch#http://netlogoweb.org/assets/modelslib/Sample%20Models/Social%20Science/Economics/Wealth%20Distribution.nlogo

http://netlogoweb.org/launch#http://netlogoweb.org/assets/modelslib/Sample%20Models/Biology/Flocking.nlogo

http://netlogoweb.org/launch#http://netlogoweb.org/assets/modelslib/Sample%20Models/Social%20Science/Rebellion.nlogo

Uses of ABM - Parameter Testing

- ABMs can also be used to test for asymptotic behaviors of a complex system based on different parameters
- In the wealth model, we could've tested giving more than 1 wealth, giving wealth to more than 1 other agent, etc.
- Very useful in modelling population dynamics between different species
- Example of Wolf-Sheep-Grass dynamic: http://netlogoweb.org/launch#http://netlogoweb.org/assets/modelslib/Sample%20Models/Biology/Wolf%20Sheep%20Predation.nlogo

MCM Problem: 2019 A - Game of Ecology

- The problem asks for the effect of releasing dragons into Earth's ecology
- How do we model the Agents (dragons)?
- What attributes do they have?
- What do they do in each timestep?

MCM Problem: 2019 A - Game of Ecology

- Dragon’s attributes:

MCM Problem: 2019 A - Game of Ecology

- Dragon’s attributes:
  - Weight - destructive capabilities
  - Energy - will it survive

MCM Problem: 2019 A - Game of Ecology

- Dragon’s timestep:

MCM Problem: 2019 A - Game of Ecology

- Dragon’s timestep:
  - Decrement energy by fixed amount
  - If hungry (fullness < hunger_threshold):
    - If enough food in current square:
      - Increase fullness, decrement resources
    - Else:
      - Migrate to new square
  - If energy > growth_threshold:
    - Trade energy for weight
  - If energy < shrink_threshold:
    - Trade weight for energy
  - If weight <= 0:
    - die

MCM Problem: 2019 A - Game of Ecology

- The world is composed of 20 x 20 squares, each have the following
  - Deers - what the dragons eat, incremented each turn, but dragons can kill them faster
  - Trees - decremented by fixed amount for each step there’s a dragon on it, grows back o/w

MCM Problem: 2019 A - Game of Ecology

Refer to Dragons.ipynb