Agent-Based Model Implementation Lecture 4

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Contents

Stochasticity

Stochastic Model have processes that are at least partly based on random numbers or events (Railsback & Grimm, 2011).

Interaction of agents with their environment and movement is based upon rules, assumptions and probabilities.

- Random numbers
- Random events

Stochasticity

- How to generate random numbers in NetLogo in observer window

  show random 100 for integer

  show random-float for real number

- Types of random distribution

  random-poisson mean

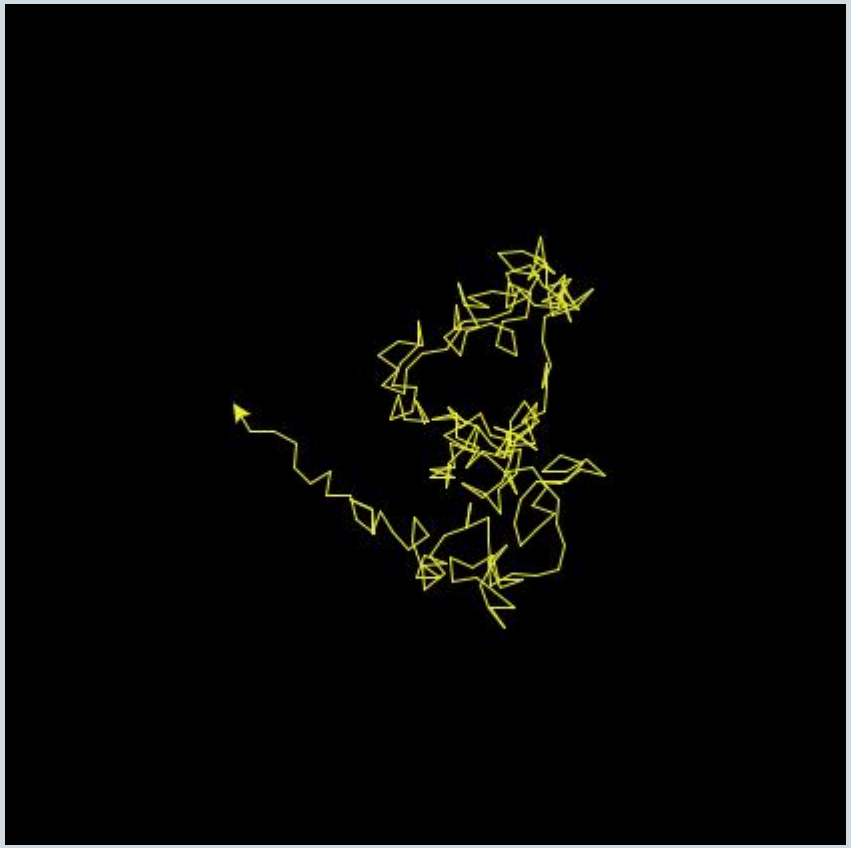
  random-normal average stdev

  random-exponential average

  random-gamma alpha lambda

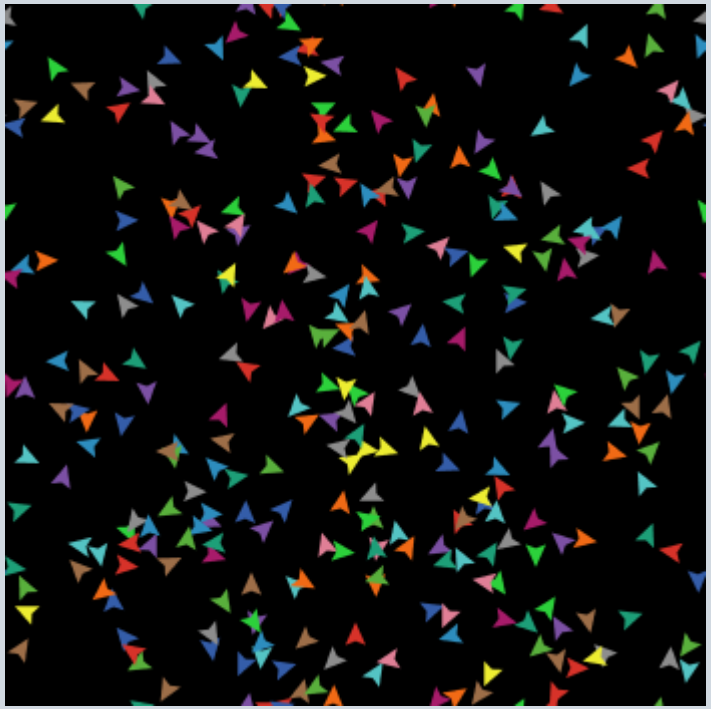
Example 1 (Random Walk)

```
to setup
  clear-all
  create-turtles 1                    ; create one turtle
  [
    set color yellow
    pen-down
  ]
  reset-ticks
end

to go
  ask turtles [
    rt random 360              ; set random heading
    forward 1                ; advance one step
  ]
  tick
end
```



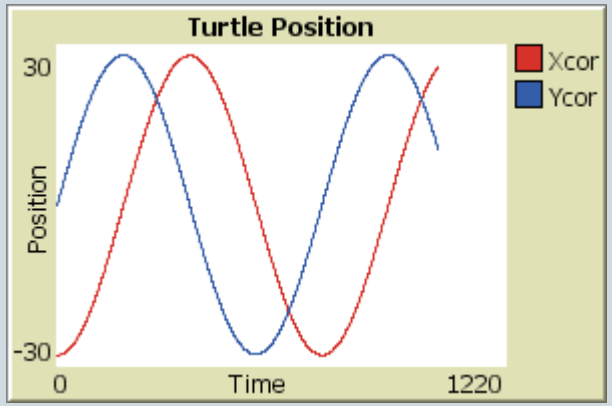
Example 2 (Scatter Example)

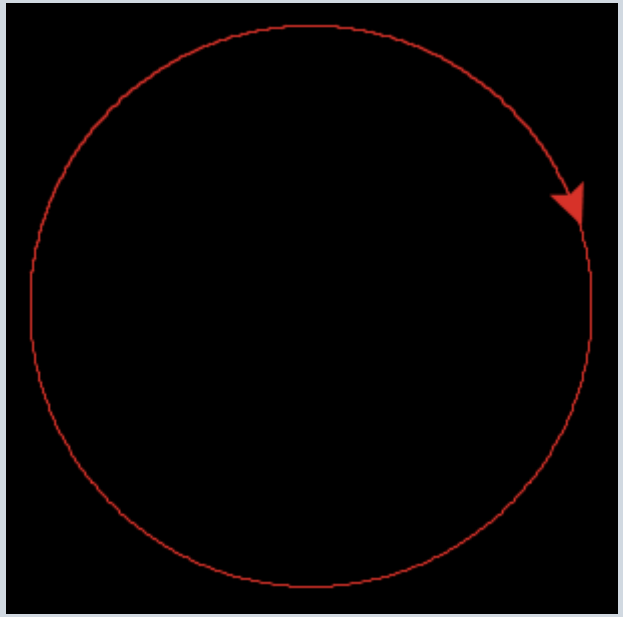
```
to setup
  clear-all
  create-turtles 300
  reset-ticks
end

to scatter1
  setup
  ask turtles [
    setxy random-xcor random-ycor
  ]
  display
end
```



Example 4 (Plotting Example)

```
to setup
  clear-all
  create-turtles 1
  [set color red
    set xcor (2 + min-pxcor)
    set ycor 0
    set heading 0
    set size 5
 pen-down
  ]
  reset-ticks
end

to go
  ask turtles
  [
    fd (pi * (max-pycor - 2) / 360)
     rt 0.5
  ]
  tick
end
```

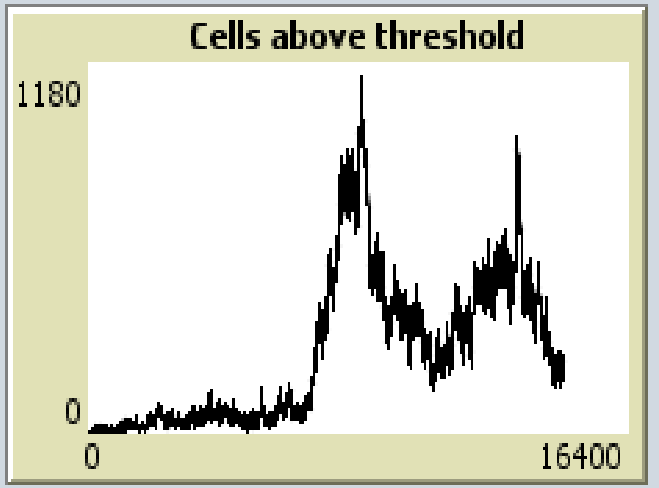


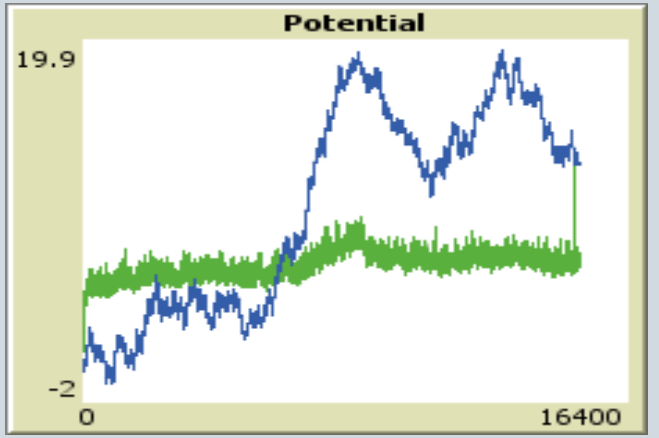


Example 5 (Stochastic Patchwork)

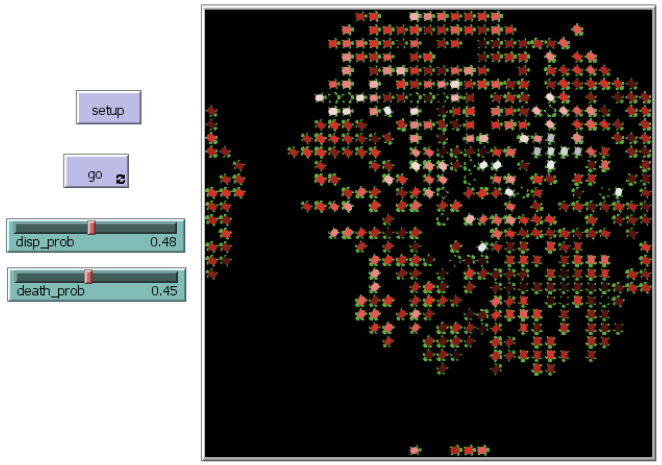
Example 6. (Urban Suite)

```
patches-own [potential new-potential]

to setup
  clear-all
  ask patches [ set potential one-of [1 -1] ]
  reset-ticks
end

to go
  ask patches [ set new-potential (potential + sum [potential] of
neighbors4) / 5 + one-of [1 -1] ]
  ask patches [ set potential new-potential
                if potential > threshold [ set pcolor white ] ]
  tick
end
```

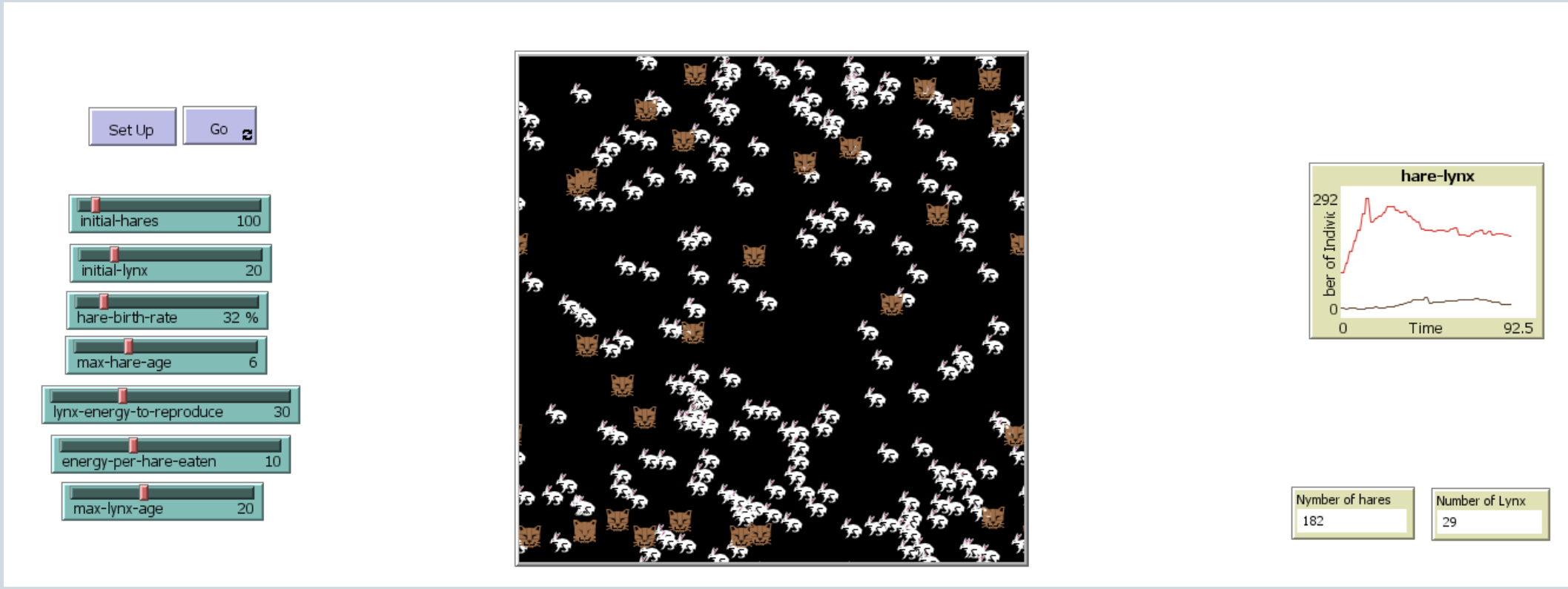




Example 7 (NetLogo Dispersal)



Example 8. (Lynx and Hares)



Uncertainty

- Random number -> uncertainty
- Uncertainty from single system-level pattern or multiple patterns observed in system at different spatial and temporal scales.
- To explore such uncertainty through the ability to generate possible future scenarios instead of generating definitive models with strong predictive assumptions (Epstein 1999).

Uncertainty

To minimize uncertainty

- Multiple assumptions might reduce uncertainty.
- Optimization of goodness of fit against actual data.
- Identification of parameters relevant to simulations over multiple periods and processes.

Verification

According to Rand and Wilensky (2006)

"Model verification is the determination of whether the implemented model corresponds to the conceptual model."

"Replication aids in the model verification process because if two distinct implementations of a conceptual model are able to produce the same results then that supports the hypothesis that the original model correctly implements the conceptual model. During the model replication process if differences between the original model and the replicated model are discovered, it is not guaranteed that the replicated model needs to be fixed. It may also be the case that the original model is not a verified, correct implementation of the conceptual model."

According to Batty (2012)

"Calibration of the parameter values ensured that the model might be tuned most effectively to the system in question."

Model behaves as expected.

Validation

According to Rand and Wilensky (2006)

“Model validation is the determination of whether the implemented model corresponds to and explains some phenomenon in the real world.”

Goodness of fit can be means of validation.

“Validation is the process of making sure that an implemented model matches the real-world”. (North and Macal 2007 , pages 30–31). “

*The model adequately represents the phenomenon of the system being modelled and involves the goodness-of-fit of the model to data (*Crooks & Heppenstall, 2012).

Validity not a binary event (valid or invalid).

Certain degree of validity by various measures of fit.

Publication outlet for ABM

Complex Adaptive Systems Modeling

Ecological Modeling

Environmental Modelling & Software

Journal of Artificial Societies and Social Simulation (JASSS)

Journal of Complexity

https://www.openabm.org

http://ccl.northwestern.edu/netlogo/models/community/index.cgi

References

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