Agent-Based Modelling and Simulation with NetLogo

Day 2: Session 5

Plotting and batch simulations

Session 5 Outline

- Creating model reporters.
- Plotting on NetLogo.
- Model parameter space.
- Designing simulation experiments.
- NetLogo behaviour space & batch simulation.

Creating model reporters

- Measurements about values you want to extract from a model.
- **Examples:**
  - Percentage of agents that execute a specific behaviour.
  - Number of agents with a given property.
  - Distribution of a particular agent property.
- The reporters can be used by plots and behaviour space to export data about your model.

Plotting in NetLogo

- **Plots** can be created using the NetLogo **interface builder**.

- Each plot contains a number of **pens**.

- **Each pen draws** lines, points or bars in the plots and can be configured by edditing the plot in your model interface.

Updating Plots in NetLogo

- Each pen is associated with a command:
  - plot value
  - histogram list
- **Example:**

  plot count turtles with [color = blue]

  histogram [age] of agents

Note: using the command **of** with an Agentset (agents, turtles, or patches, etc) results in a list of values.

Updating Plots in NetLogo

- The plots in a NetLogo model are update automatically with the **tick** command.
- This means that each time **tick** is called the plots run the commands in each **pen**.
- To use automatic plotting in your model you need to use the following configuration:

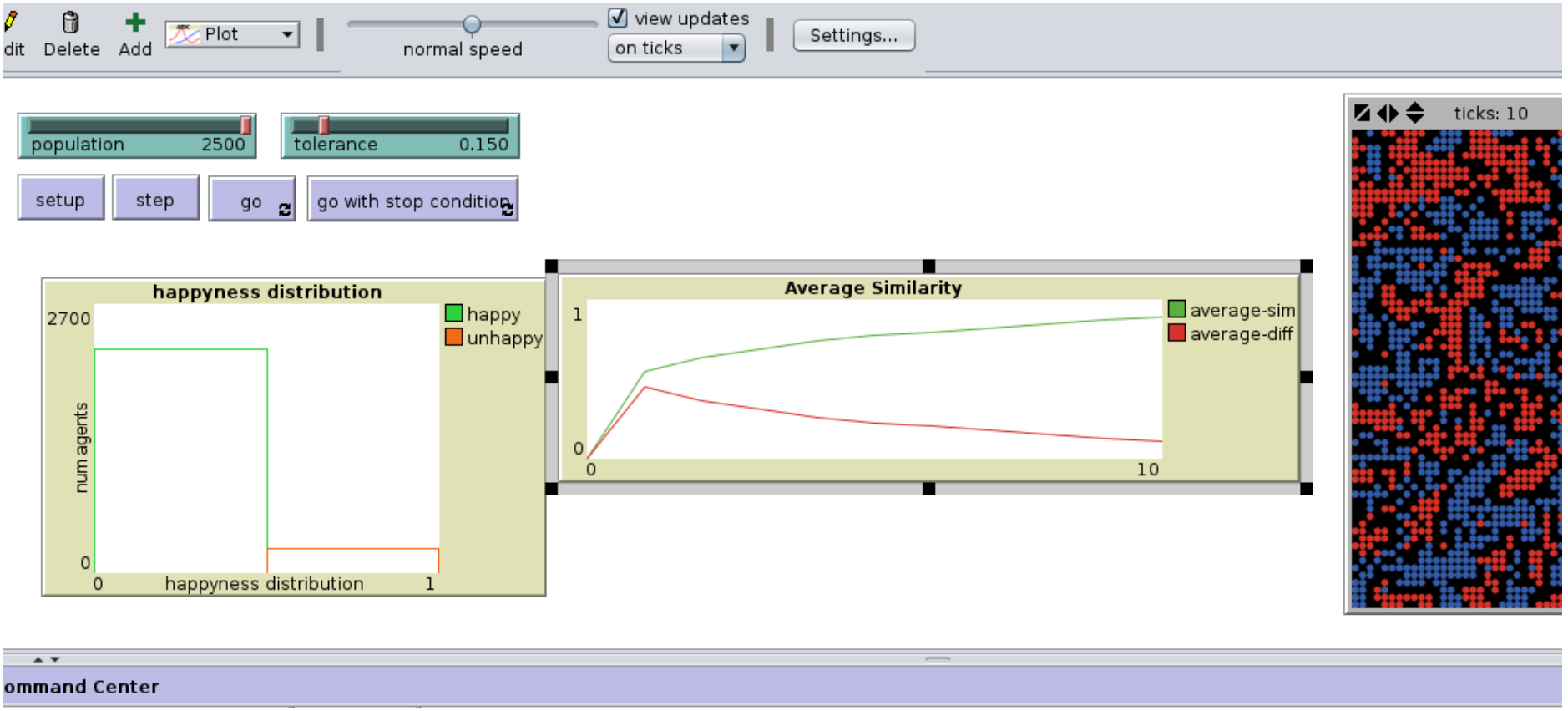
```
to setup
  clear-all
  ...
  reset-ticks
end

to go
  ...
  tick
end
```

Exercise: segregation with plots

- Try to add a plot to the previous segregation model.
- **Suggestions:**
  - Plot the evolution of "happyness" over time (number of agents happy with their neighbourhood).
  - Plot the average neighbourhood similarity ratio over time (sum similar neighbours / sum total neighbours)
- **Starting point:** last segregation model developed.
- **Solution:** *"segregation plots.nlogo"*

Result


dit
Delete
Add
Plot
normal speed
view updates
on ticks
Settings...
population 2500
tolerance 0.150
setup
step
go
go with stop condition
happyness distribution
2700
0
num agents
0
happyness distribution
1
happy
unhappy
Average Similarity
1
0
0
10
average-sim
average-diff
ticks: 10
ommand Center

Collecting Results

- Export:

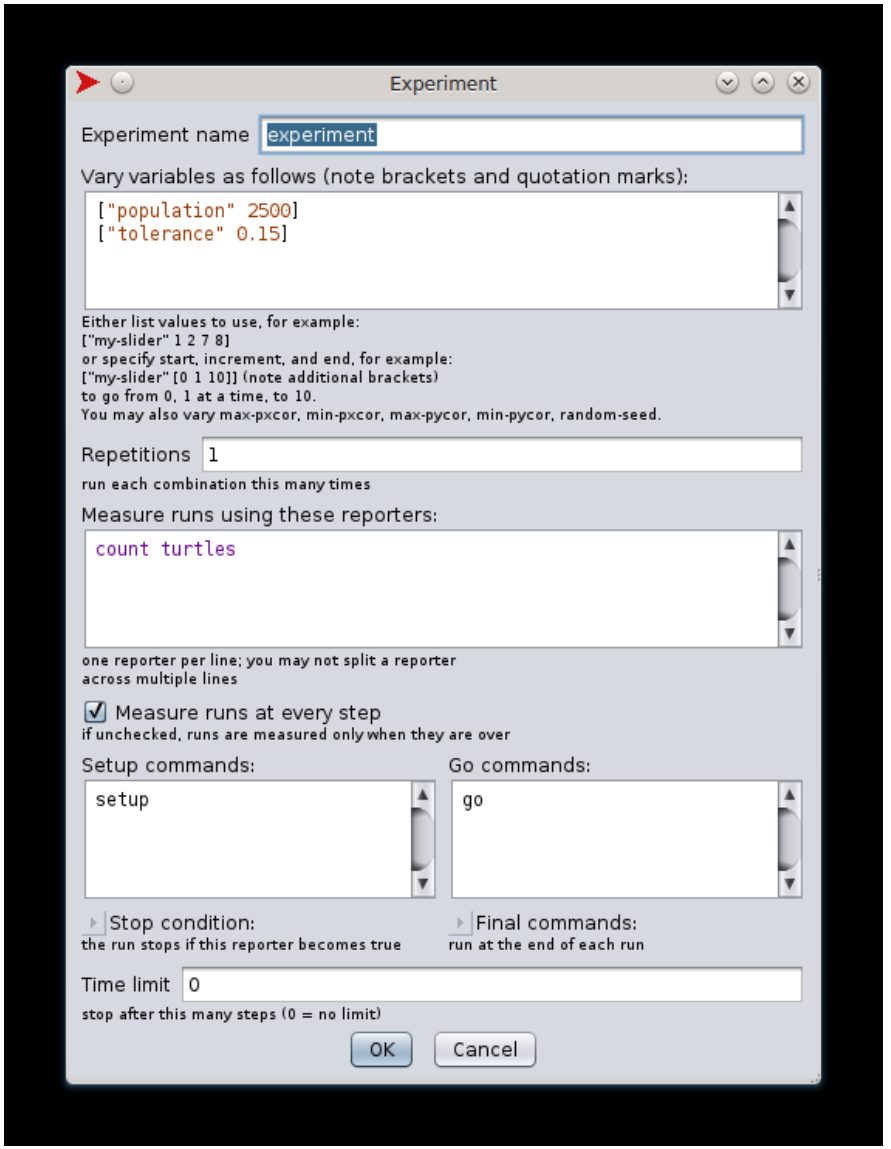
  (File > Export)

  - World View: as image
  - Plots: as .csv file
  - Output: saves the text from the text output area.
- Behaviour Space

  (Tools > BehaviourSpace)

  - allows for the configuration of multiple simulation runs by sweeping accross different parameter values.
  - The results are exported to a .csv file

Behaviour Space



Behaviour Space

- http://ccl.northwestern.edu/netlogo/2.0/docs/behaviorspace.html
- The user defines a set of parameter value sequences.
- The parameters sequences are typically associated with slider values and other interface components.
- The behaviour space sweeps accross all the combinations of the specified parameter values.
- Configures the model with each parameter combination.

Behaviour Space: parameter sweeps

- **Single value:** ["population" 2500]
- **Multiple values:** ["population" 1 2 3 100 200]
- **Sequence:** ["population" [1 10 100]] (from 1 to 100 with increments of 10)
- You can define a parameter sweep in each line, the behaviour space will then combine all the values from the multiple parameters.
- **Note:** the parameters you do not assign to a sweep in the behaviour space remain with the value given in the interface.

Behaviour Space: measuring models

- You can specify how the model is measured by stating what reporters will be applied to the model.

- You can also specify if the simulation is measured step by step or just at the end.

- **Tip:** to compute a simple average, don't configure behaviour space to call the reporter in every step, accumulate the value and report the results at the end.

Designing Experiments

- Large parameter spaces can lead to infeasible simulation batches.

- To design a parameter space you should:
  - Explore the model first.
  - Reflect upon what questions do you want to answer.
  - Configure the behaviour space to explore "interesting" parameter domains.

Interesting tools for parameter exploration

- MEME: model exploration module http://mass.aitia.ai/downloads/meme-material

- Simulation model experiment description and communication: Opening the ‘Black Box’ of Simulations:

  "Transparency of Simulation Models and Effective Results Reports Through the Systematic Design of Experiments" (Lorscheid 2011)

Behaviour Space Exercise

- Create a simple batch experiment for your segregation model.
- Output the results to a .csv file
- Observe the produced output and confirm if the simulation runs produced the intended results.

Next Session...

- The importance of social spaces.
- Discrete, continuous, networks and other abstractions.
- Complex social network models.
- Networks in NetLogo: using Links.
- Scale--free network model in NetLogo.