Practical and assignment agent-based-modelling

Course: Data Science for Healthy Lifestyles

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Practical: Introduction to agent-based modelling in NetLogo (2 hours)

NetLogo is a free, opensource software that can be used to build and run agent-based models. In this practical you will learn the basics of NetLogo and build your first agent-based model. Make sure NetLogo is installed on your laptop or you have access to NetLogo on your WUR-account.

We will learn using NetLogo by following these online tutorials:

https://ccl.northwestern.edu/netlogo/docs/tutorial1.html

https://ccl.northwestern.edu/netlogo/docs/tutorial2.html

https://ccl.northwestern.edu/netlogo/docs/tutorial3.html

These tutorials will help you to understand the basics of NetLogo and provide you with enough knowledge to advance to the assignment. You do not need to hand in your results from the tutorials.

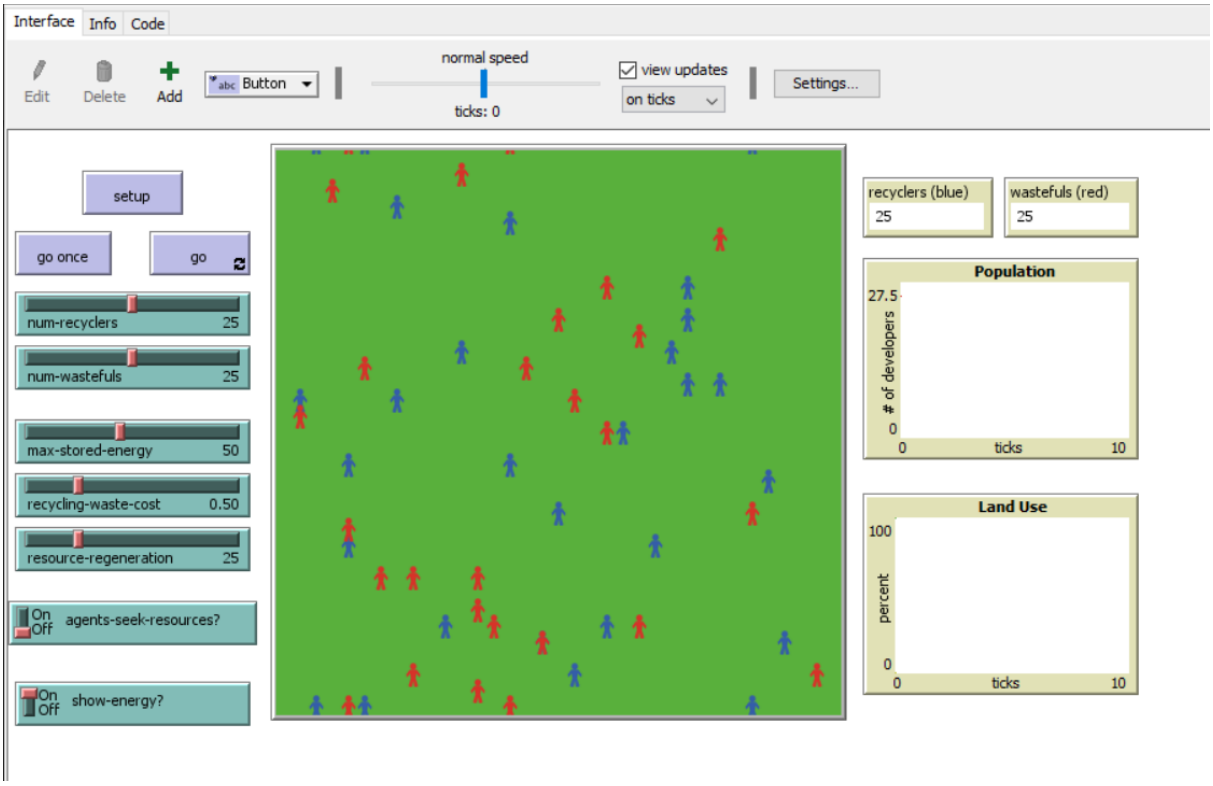

Figure 1 Screenshot of Urban Suite - Recycling, an example model from NetLogo's model library

Assignment: Simulation of resource exchange – Awareness (20 hours)

Introduction

NetLogo has an extensive Models Library with free example models. These can be used to learn about possibilities of agent-based models and improve your skills in building these models. For the assignment we will use the "Awareness" model. (File – Models Library – Curricular Models - Urban Suite – Awareness)

After completing the assignment, the student:

- Has gained insight in how information, ideas or behaviour can spread amongst a population over time
- Has familiarized itself with assumptions underlying a specific agent-based model
- Has basic understanding of the effect of input parameters on the outcome parameters (=model sensitivity)

Hand in your assignment in a Word document including your name and student number. Send along your own model that you develop in the third part of the assignment.

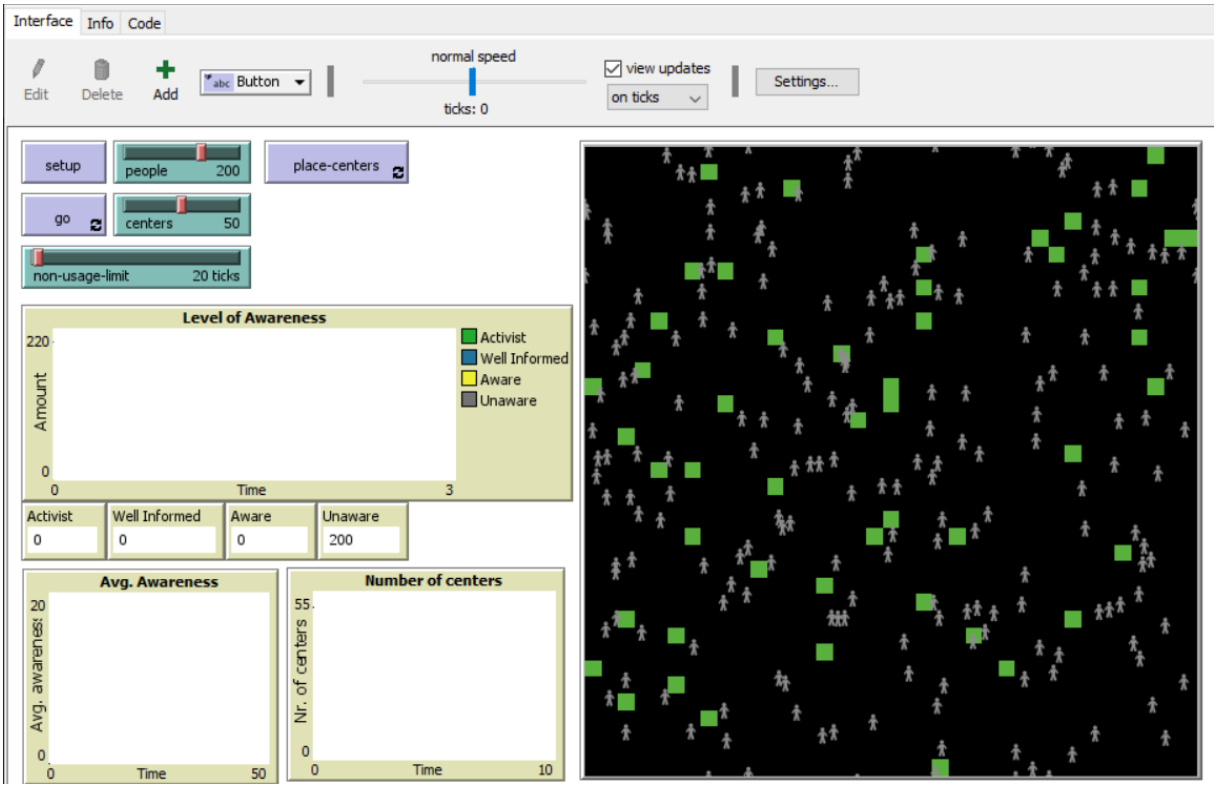

Figure 2 Screenshot of Urban Suite - Awareness, an example model of NetLogo's model library

Assignment

1. **Explore the Awareness model (~3 hours).**
    a. Have a look at the Interface and the Code and read the first three paragraphs of the Info tab (What is it? | How it works | How to use it).
    b. Read the fourth paragraph of the Info tab (Things to notice). Try a few runs with different parameter settings. Start running the model for ±500 ticks. If you want, you can also add code and an input parameter to run the model for a fixed number of ticks. What do you observe?
    c. Vary only the "people" parameter at the start of the model run. What happens to the outcome variable Level of Awareness? And what happens to the Average Awareness and the Number of Centers?
    d. Also vary "centers" and "non-usage-limit". What happens to the outcome variables?

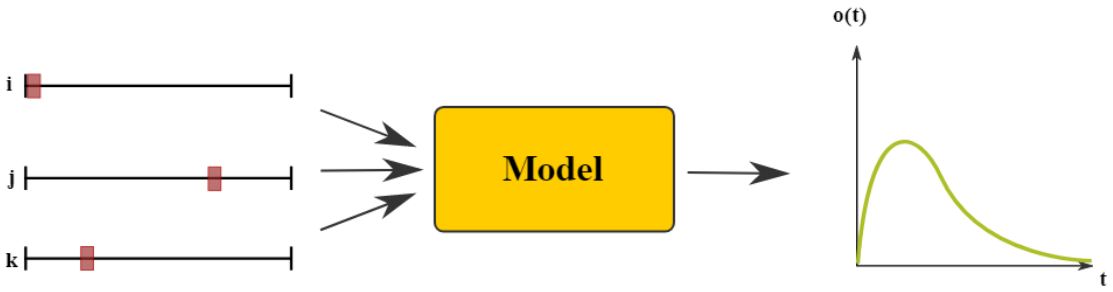

Figure 3 Illustration of a sensitivity analysis. You vary one or more parameters and observe how it affects the outcome. Source: Openmole.org

    e. Now perform a full sensitivity analysis of the model. Choose at least four values to test for each parameter. Each time, run the model for 1000 ticks. You can do the analysis manually: change each parameter in the user interface, run the model, and record the outcomes in the example spreadsheet (example sheet sensitivity analysis abm netlogo awareness.xlsx). Or you can use the build-in tool for sensitivity analysis (Tools - BehaviourSpace).
    f. Interpreting the results of your sensitivity analysis is a lot easier when you create graphs. Make some appropriate graphs to compare the runs to each other.
    g. For which of the input parameters is the Awareness model most sensitive? Meaning: what parameter has, when you change it, an impact on one or more of the outcome variables? Which input parameter seems essential to turn all people into activists or unawares? How do the initial settings influence the number of ticks (=duration) it takes for the model to enter a steady state (=stable situations with only small fluctuations). And which input parameter does not seem to influence the outcome of the model that much? Include graph(s) to support your answers.

2. Understand the Awareness model (~2 hours).

a. Read the fifth paragraph of the Info tab (Things to try). Try the suggested parameter settings and answer the questions.

b. Like every other simulation model, for the Awareness model assumptions had to be made to represent reality in a virtual environment. For example, in the Recycling model of NetLogo it is assumed only two, opposite types of people exist: recyclers and wastefuls. Now you have explored the Awareness model and read the Info tab, what assumptions do you think are made for this model? Try to list at least five assumptions.

c. Which assumptions do you think are realistic? And which ones do you think are not (so) realistic? Explain why.

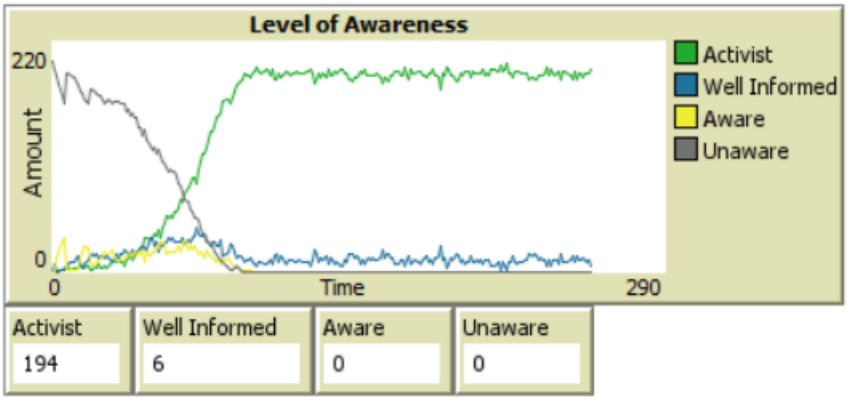

Figure 4 Screenshot of the Level of Awareness graph where the majority of people is an Activist.

3. Extend the Awareness model (~15 hours).

In the Consumption & Healthy Lifestyles group, one project uses agent-based modelling to explore trends and mechanisms of the protein transition. The protein transition is the preferred societal shift from mostly animal-based protein consumption to more plant-based protein consumption. Background information about the project and the protein transition can be found here: https://www.wur.nl/en/project/Protein-transition-in-a-dynamic-food-environment-A-systems-approach.htm

The Awareness model is a simplified, general model to simulate how information, ideas or behaviour spread amongst a population over time. Now imagine you want to use this model to better understand the protein transition.

a. Formulate a specific application of the Awareness model for a topic that is part of the protein transition. Feel free to come up with your own idea, still here are some suggestions:
    i. Transferability of cooking skills for plant-based protein foods
    ii. Prevalence of laymen beliefs about meat, dairy, or plant proteins. E.g., "Meat/dairy is essential to my health", "Plant foods do not provide enough protein to me"
    iii. Popularity development of novel meat alternatives
b. What changes or additions will you make to the Awareness model? You can find a suggestion in the sixth paragraph of the Info tab (Extending the model), or explore some of the other models in the Model Library for some inspiration. What question do you want to answer with your model? Think of the topic and aim of your model, assumptions that you make, and the input parameters and output variables that you will use. Write everything down in max. ½ A4.
c. Now make the necessary changes to the Awareness model and create your own agent-based model.
d. Perform as many runs as necessary to answer your question following the procedure for sensitivity analysis that you applied in the first part of the assignment. Write down the results in max. 1 A4 and support them with graphs.