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COMPUTER SCIENCE DEPARTMENT

# INTRODUCTION TO AGENT-BASED MODELS

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**FINAL ASSIGNMENT** **Due by:** 23 november 2021

**Abstract**

The last assignment for the course is to prepare an agent-based model and present it to the class. This Final Assignment will encompass a sequence of activities described below, where you'll pick a theme to explore, build the conceptual model, implement it on Netlogo and do the analysis to find out if your model is correct and presents trustable results.[1].

## Task 0: Concepts

For the final assignment you will watch a set of videos from the Introduction to Agent-Based Modeling course, by Santa Fe Institute.

These videos will provide you with the descriptions of each part of this assignment, including the conceptualization of the model and the seven design choices needed to conceive it.

For that, watch the following videos:

1. Model Construction Overview
2. Designing the Model
3. Seven Design Choices - Part 1
4. Seven Design Choices - Part 2

The project consists on following the method proposed by [1] in Chapter 4. That is:

1. Design the Model
2. Build the Model
3. Analyze the Model

Below we will specify each step of the project.

[1]Last update: October 19, 2021

## Step 1: Design the Model

Designing the model is the first step and it is rather important that the decisions made for the project are well thought to reduce the chances of future problems when building or analyzing it.

According to [1], there are two design decision methods to follow: (1) phenomena-based model and (2) exploratory model.

Method (1) is advisable if you know the characteristics of the reference pattern of the phenomenon you want to model. This is the case for the Schelling model, for instance, or for the starlings murmuration model. In both cases you know what to expect after building the model, so you will try to create the rules and attributes accordingly.

Method (2) is recommended in case you want to explore the phenomenon without having a clear idea of how is the pattern. For this situation, you'll start with a basic set of mechanisms and from there on explore what is generated from the mechanisms implemented.

**Decide which of the two methods is related to your work, after considering what sort of model you want to build.**

In this phase you'll also decide if you want to use a top-down or a bottom-up approach in your method. As seen in the examples so far, most ABMs are bottom-up, starting from the agents attributes and rules and building it up to the whole structure of the model. In this case, the conceptual model and the code will grow together as you create the model. The other approach is the top-down, where you start from the components and design to later put them together. In this case, you build separate parts of your model to then see how they work together. Most ABMs use both bottom-up and top-down methods in different ways. It is rare to find ABMs purely using one of them. **Describe in your report how the two methods were used.**

One important tip is to keep your model as simple as possible, and increase the complexity according to the needs you have. To do so, work towards a concrete question, and do not add content that does not help to answer the question, even if it is tempting to make the model more realistic.

This part of the report should also have a discussion and answer the questions related to the Seven Design Choices:

1. What part of your phenomenon would you like to build a model of? (Scope / Question)
2. What are the principal types of agents involved in this phenomenon? (Agents)
3. What properties do these agent have (by agent type)? (Properties)
4. What actions or behaviors can these agents take (by agent type)? How do these agents interact with each other or with the environment? (Behaviors)
5. In what kind of environment do these agents operate? Are there environmental agents? (Environment)
6. If you had to define the phenomenon as discrete time steps, what events would occur in each time step, and in what order? (Time Step)
7. What do you hope to observe from this model? (Inputs and Outputs)

After creating the concepts and structure of your model, it is time to build it!

## Step 2: Build the Model

At this part of your final assignment you should have a draft of what is in your model and what needs to be implemented. That doesn't mean you won't have to adapt, adjust and review some of the decisions made before-

hand. The process of building models is cyclical and requires constant awareness of poor decisions made that need improvement.

You will build your model on Netlogo, and will report the structures used in it. Have you used networks? Or GIS information? Or lists? Make sure your final report dedicates subsections explaining the main parts of your model and how the data structure was built.

Make sure you keep control of the changes and increments for the model as you go. All this information is crucial for the evaluation of your work.

**Save your code on a GitHub repository, and document it well inside Netlogo and also using a README.md file in the same folder of the code.**

## Step 3: Analyze the Model

After building the model is time to answer the question raised at the beginning. For that, it is important you run your model multiple times if it has stochastic elements altering the input parameters and the seed for the random generator.

**Use the BehaviorSpace tool found in the Netlogo, take the data and analyse it using statistical analysis (of your choice) and graphics.**

## Submit the following:

The full report with all the steps completed and well detailed.

In the report, **include the link to the GitHub repository where your code is saved**.

If you run out of ideas for your project, it is recommended you visit the Netlogo Web Examples Repository. You can also discuss your ideas with other colleagues and the teacher of the class, but remember that **your project is solo**.

## References

[1] Uri Wilensky and William Rand. *An introduction to agent-based modeling: modeling natural, social, and engineered complex systems with NetLogo*. Mit Press, 2015.