An introduction to agent-based simulations in the Julia language

Julia is a new Open Source language designed for science and numerical computing. Since 1.0 version release in August 2018, an exponential growth of language popularity has been observed. Julia takes "walks like Python, runs like C" approach and offers a syntax similar to Matlab and Python yet with speed of C++. This makes it a perfect tool for scientific computing and running large scale simulations.

The goal of this workshop is to show how Julia language can be used to create agent-based simulations in social sciences. The workshop will consist of thee parts presenting increasingly advanced simulation models implemented in Julia. We start with a basic model of a financial market that should be easy to implement even by users without experience in Julia. Next we present how the classic predator-prey model can be simulated using Julia. We end with an example showing how agent-based simulations can be integrated with real geospatial data from OpenStreetMap.

For this workshop, no prior knowledge of Julia is expected. Basic programming skills and a fundamental understanding of ABMs will be beneficial.

Before the workshop you are recommended to install the following components on your computer: Julia 1.8 (https://julialang.org/downloads/), Visual Studio Code (https://code.visualstudio.com/), and Julia extension to Visual Studio Code (https://www.julia-vscode.org/docs/stable/).

Part 1: Introduction to agent-based modeling with Julia (Bogumił Kamiński)

In this part of the workshop you will learn the basics how to start using the Julia language for agent-based modeling. You will be guided through your first Julia session and we will replicate the Cont model of volatility clustering on financial markets.

The code we will use is available at https://gist.github.com/bkamins/7038c6814a36416a3c21c87b641511b3. A blog post showing material related to the content discussed during the workshop can be found at https://bkamins.github.io/julialang/2020/07/11/cont.html.

Part 2: A Speedy Implementation of a Predator-Prey Model in Julia (Rajith Vidanaarachchi)

This part of the tutorial will showcase how to set up a Predator-Prey model in Julia with minimal effort and time.

In an ABM, we conceive the idea of an Agent as an abstraction of the real world. These abstractions usually involve spatial and non-spatial components. This tutorial will focus on how to translate our abstract Agents into concrete Agents in Julia. After this tutorial, you will be able to quickly prototype an Agent-Based Modelling environment in Julia, consisting of heterogenous agents who interact in a 2D space. Further, you will gain knowledge on connecting peripheral packages in Julia to explore and analyse the data output by the ABM.

The GitHub repository of the model is available at https://github.com/rajithv/PredatorPreyTutorial.

Part 3: Simulating a Zombie pandemic in an urban setting (Przemysław Szufel)

An urban transportation system can be represented as a complex directed graph where vertices are spread an Euclidean space. This representation can be a baseline component for various ABM models in an urban setting. In this tutorial a simple model of a Zombie pandemic within a city will be presented. The agents will roam across streets of central Toronto. We will discuss how real-world spatial data can be integrated into an ABM model, how to represent routes of agents and how to include external data such as a public transportation system into such model. Additionally, during the workshop it will be mentioned what are good strategies for running the simulations in scale and collecting the output data. In this part of the workshop the Julia programming language will be used including libraries Graphs.jl (for graph representation), OpenStreetMapX.jl (for spatial data processing), Plots.jl (for simulation result visualization). Additionally, we will show how ABM models implemented in Julia can easily use any Python's libraries for visualizing computation state.