Figure 1: Troll farm engaged in spreading fake news.

Fake News

Motivation

The spread of misinformation, especially the deliberate spread of fake news, for example via troll farms, has become a pressing challenge in the digital age. Opinion dynamics, the study of how individual opinions evolve through interactions with others, offers a framework for modelling how fake news proliferates and influences public opinions. Although it is a simplistic model, it provides insights into the spread of fake news in a network of people, be it in a social network or in society in general.

Model

Consider a population of a large number of N people (agents). They are positioned on a rectangular grid, such that each individual is connected to a set of other individuals via a type of neighbourhood (Moore, von Neumann, etc.), with periodic boundary conditions. Each individual i has a certain belief $b_i \in [-1, 1]$, which can change over time. Here, -1 denotes the belief in a fake news story and 1 denotes the opposing view fact-checked by a reliable news outlet. Furthermore, every individual i has measures of their power to convince others $c_i \in [0, c_{\max}]$, with $c_{\max} \in [0, 1]$. The convincing powers c_i stay constant over one simulation run. Initially a fraction p_+ of the population has a belief drawn from a uniform distribution in the range $[0, 1]$, the rest has their belief drawn from a uniform distribution in the range $[-1, 0]$. In each timestep we randomly pick 10% of the population and change their belief according to

$$b_i \to b_i + \frac{1}{n} \sum_{j \in N_i} c_j b_j, \tag{1}$$

truncating values smaller (greater) than -1 (1) to -1 (1). Here N_i denotes the neighbours of agent i and n is the number of neighbours.

ToDo's

Task 1

Implement the basic model with a von Neumann neighbourhood and parameters $N = 10000$, $c_{\max} = 0.5$, $p_+ = 0.8$. Come up with at least three global observables that characterize the population as a whole and that change in time, discuss their time evolution and visualize the dynamics of the system.

Task 2

Introduce trolls into the model. They are characterized by their belief in the fake news $b_i = -1$, which does not change. Find which fraction of the population needs to be trolls, such that more than half of the normal population (non-trolls) have a belief $b_i < 0$ after 3000 timesteps.

Task 3

Discuss changes in the dynamics when you change the initial parameters or increase the number of neighbours. Also discuss changes, when the part of the population with beliefs $b_i < 0$ is concentrated in some region of the grid initially.

Task 4

Come up with a mechanism to counter the trolls in this model and implement it. Also discuss further possible extensions and shortcomings of this model.