Studienleistung für Komplexe Systeme

Axelrod's Dissemination of Culture and it's implementation into a python application

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Abstract

The following report is part of the study achievement for the course *Komplexe Systeme* (01-PHY-MA-TheoPhys10-V). Axelrod's model for the dissemination of culture will be explained as well as the history of the development of this and similar models. Also the python implementation of the model which was also part of the study achievement will be discussed.

1. Introduction

In 1997 the paper *The Dissemination of Culture: A Model with Local Convergence and Global Polarization* by Robert Axelrod was published in the Journal of Conflict Resolution[1]. This publication is preceded by numerous works dealing with the same or similar phenomena.

Despite all the exchange and a general tendency towards convergence, why are there still social and cultural differences existing? Previous works have given useful explanations:

People identifying with a certain group often times actively emphasize their difference to other groups[2]. For ethnic groups this can reinforce cultural boundaries[3][4].

There are certain dynamics like fads and fashion.

Preference for extreme views[5][6][7].

Drift.

Geographic isolation[8].

Specialization[9].

Change in environment.

A key principle these other mechanisms are not employing is that exchange is most successful or mostly occurring between individuals that are similar in culture.

There are dozens of different ways to define the word *culture* and most of them remain very vague and therefore hard to formalize scientifically. In his work Axelrod required culture to satisfy two conditions:

The more cultural attributes two individuals share, the more likely their interaction will be.

An interaction between two individuals tends to increase their similarity respectively the amount of shared attributes.

It intuitively makes sense that if only these conditions were implemented in a simulation, there would be a drive towards a higher similarity globally. But interestingly this does not necessarily lead to a global convergence where all individuals share all the same cultural attributes, as he shows in his paper.

The model he introduced is based on three principles:

Agent-based: The changes taking place are determined by interaction between agents and are only local.

No central authority: In this model each agent is independent of any authoritary unit, which also poses an abstraction of the real world, where powerful leaders like politicians, cult leaders heavily influence interactions.

Adaptive agents: In the model there is only an adaptive interaction taking place which is not directly following any optimization process to maximize fitness or any other rational principle.

2. The model

As already mentioned, Axelrod used an agent-based model. These are acting on a grid where the local changes given by interactions between two agents can be determined. Each agent is represented by a cultural vector with M features where each of these features could take values of the N possible traits.