Network_Modelling

Henry Biko

CS166

Network modeling is a flexible objective way of representing objects and their relationships. In class, we looked at different characteristics of network models and how they affect robustness. This characteristic included network density. We went further and even gave applications such as in electric grids, world trade, etc. We also gave comparisons between networks and cellular Automator: in networks components of a system may not be connected uniformly and regularly unlike in cellular automata that cells are connected to form regular homogenous grids. In this assignment, we would go further and suggest different update rules and how it would affect our network.

The spread of opinions, images, maladies, and alternative realities in a community depends both on the subtleties of the spreading procedure and on the structure of the social and correspondence networks on which they spread. One component that can change spreading elements generously is heterogeneous conduct among various kinds of people in an interpersonal organization. In this paper, we will explore antiestablishment nodes and how they influence the spreading dynamics of two or more competing opinions. Spreading will follow a deterministic rule for updating each node state with adjustable probability. There are two types of nodes antiestablishment that choose to adopt opinions that are less popular and conformists that tend to follow majority rule, i.e their opinion in most cases gravitate where there is the majority.

Model assumption

- Nodes are split into antiestablishment and conformists
- There are two state options either 0 or 1 that represent different opinions similar to the model that we had in class, however, at the definition level we will assume that opinions are independent of antiestablishment as well as conformity

- The transition period from one state to another is heterogeneously distributed . in our case we will use Gaussian distribution as it is the most common distribution in nature.
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The antiestablishment model would be implemented following two modes Watts-Strogatz: a random model that produces the small-world properties and Barabasi model: This one follows power to rule as we know in the real world influence is not uniformly distributed i.e there are more popular people who ten to gain agents gravitate toward following a power rule

Update rule

- Nodes are chosen stochastically, its parameter is identified on the normal curve then its trait, as well as the neighbors, are identified.
- The opinions of the neighbors are identified at the time equal to the parameter
- The opinion of the node is updated with probability p if conformist and 1-p if it has a trait of antiestablishment. **Note the sum across all p's should be equal to 1**
    - We will fix the probability of antiestablishment at 0.6 at first and make the model bias, we will analyze the output before resetting it to 0.5 and then rerunning the model

Biased model

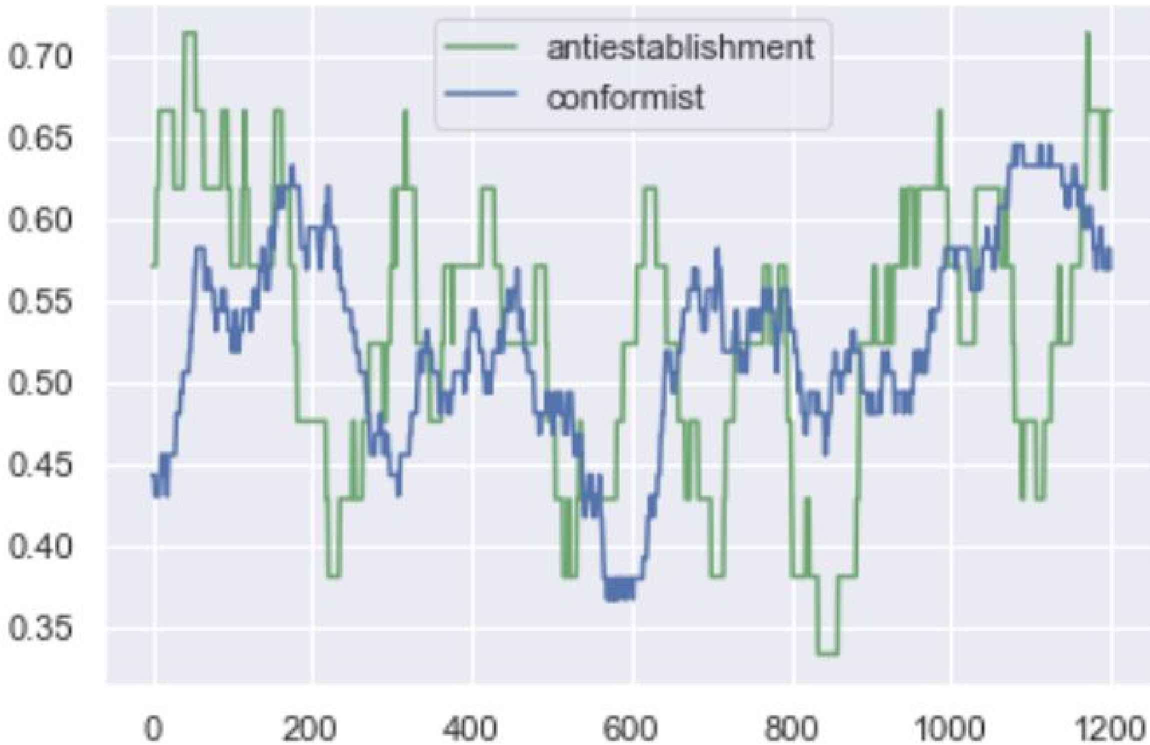
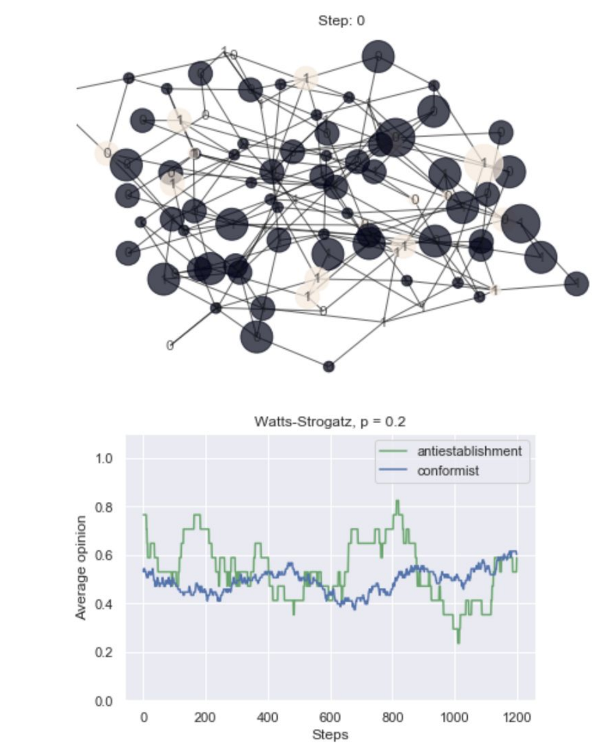


Fig 1.0: watts_strogatz_graph of the average opinion against time.

From the graph, the change to the antiestablishment starts with a high probability as compared to the conformist node. The two opinions always tend to trend in a different direction. Where the antiestablishment is the crest conformism is the trough. We should, however, note that the sum of the two probabilities at any given point in the curve adds to one.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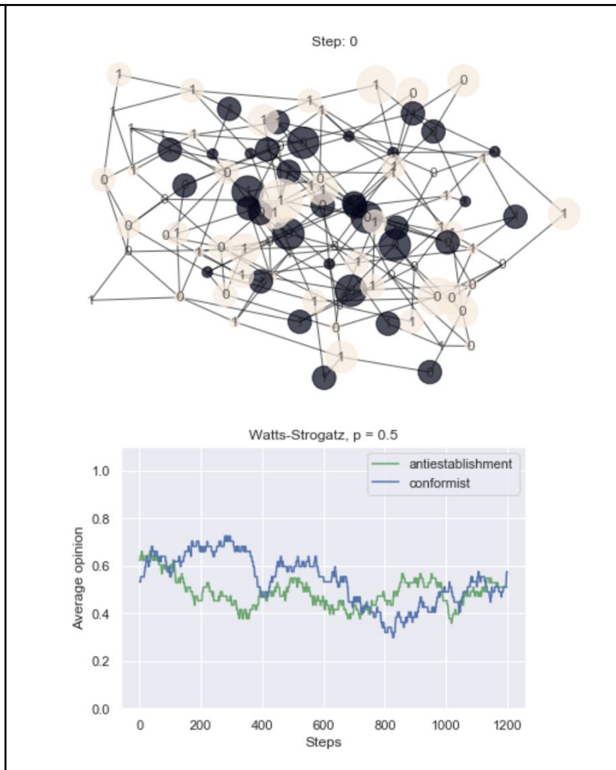
Watts-Strogatz, p = 0.2
antiestablishment
conformist
Average opinion
Steps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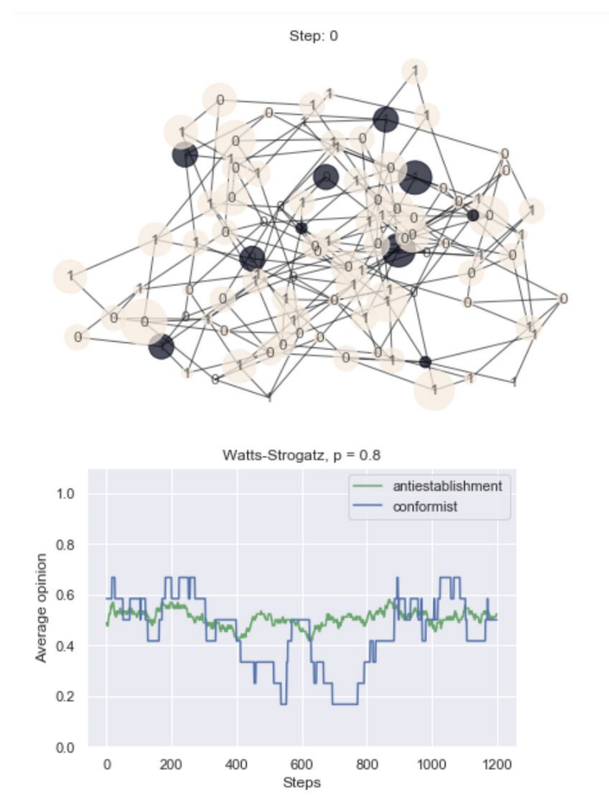
antiestablishment
conformist
Average opinion
Steps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Watts-Strogatz, p = 0.8
antiestablishment
conformist
Average opinion
Steps

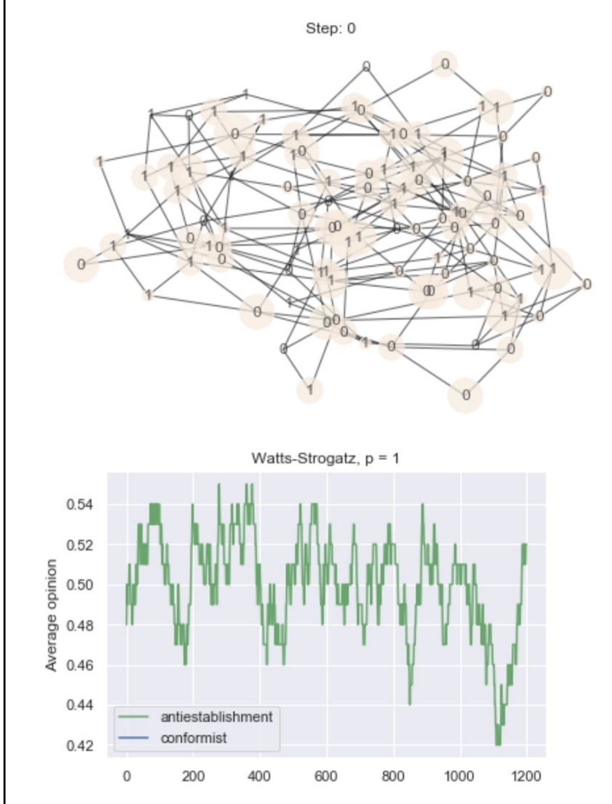
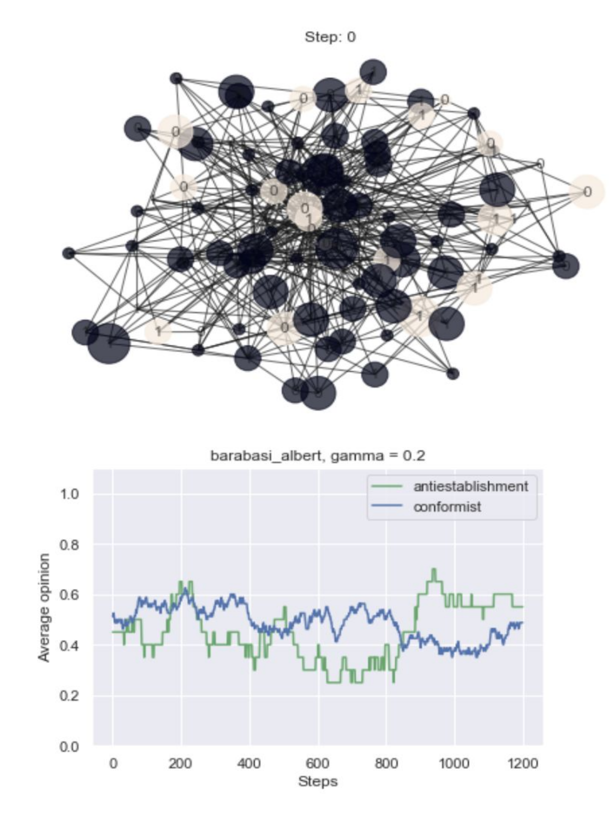
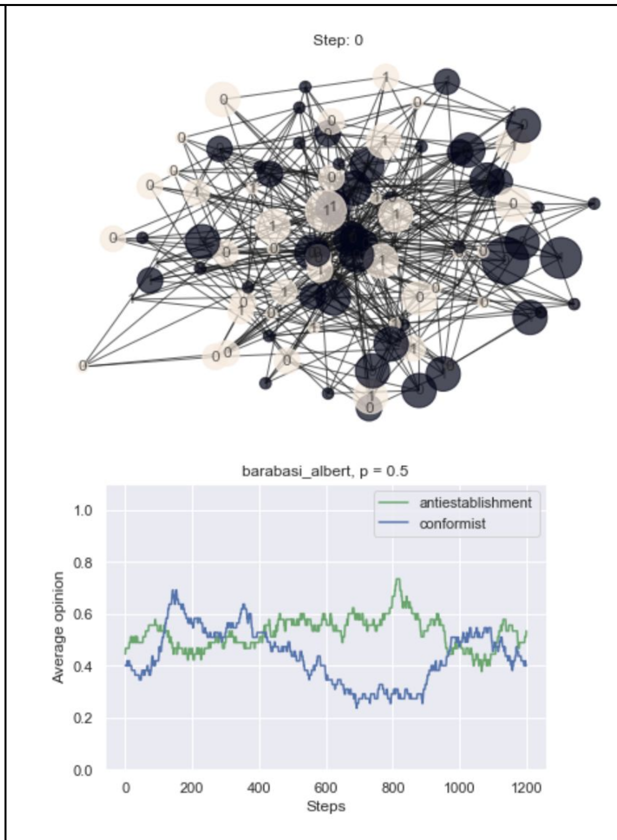

Step: 0
Watts-Strogatz, p = 1
antiestablishment
conformist
Average opinion

Table 1.0


Step: 0
barabasi_albert, gamma = 0.2
antiestablishment
conformist
Average opinion
Steps
0.0
0.2
0.4
0.6
0.8
1.0
0
200
400
600
800
1000
1200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barabasi_albert, p = 0.5
antiestablishment
conformist
Average opinion
Steps
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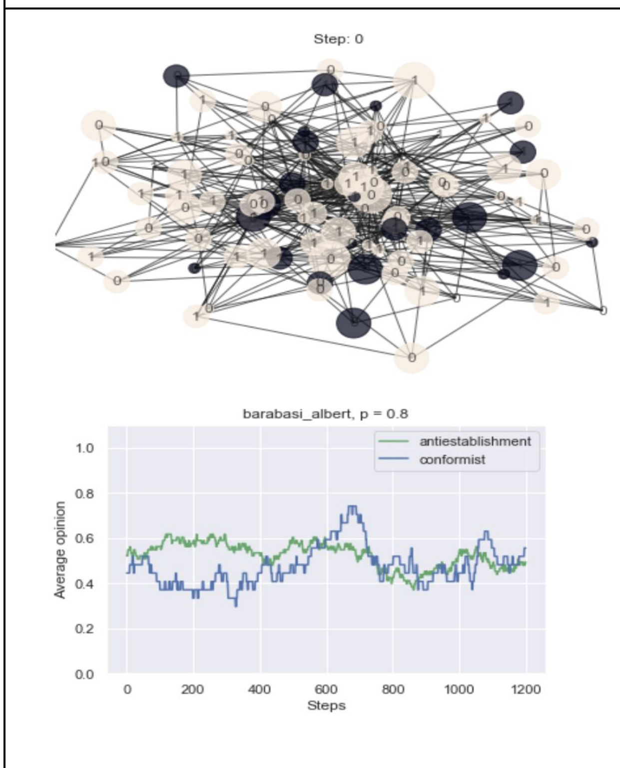
0.8
1.0
0
200
400
600
800
1000
1200


Step: 0
barabasi_albert, p = 0.8
antiestablishment
conformist
Average opinion
Steps
0.0
0.2
0.4
0.6
0.8
1.0
0
200
400
600
800
1000
1200

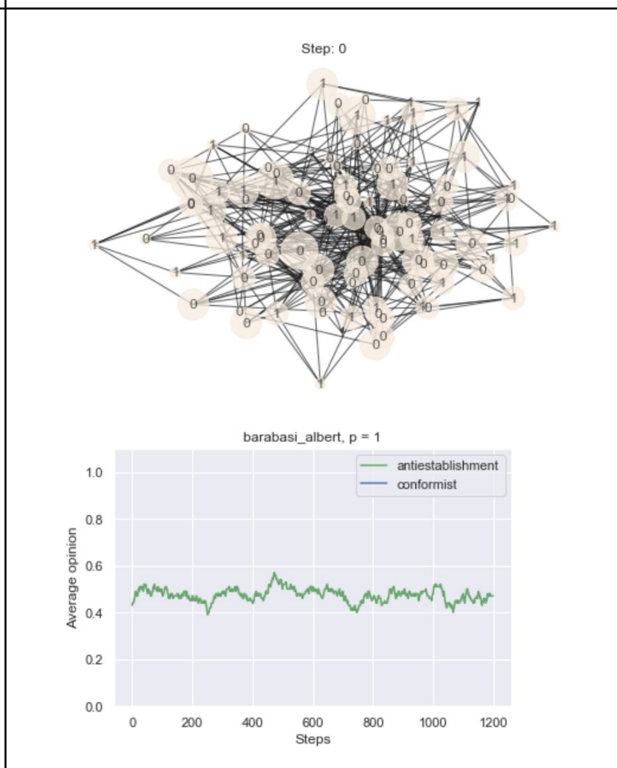
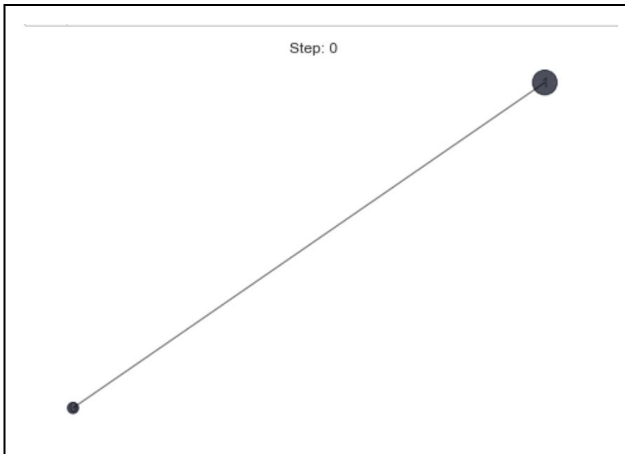

Step: 0
barabasi_albert, p = 1
antiestablishment
conformist
Average opinion
Steps
0.0
0.2
0.4
0.6
0.8
1.0
0
200
400
600
800
1000
1200

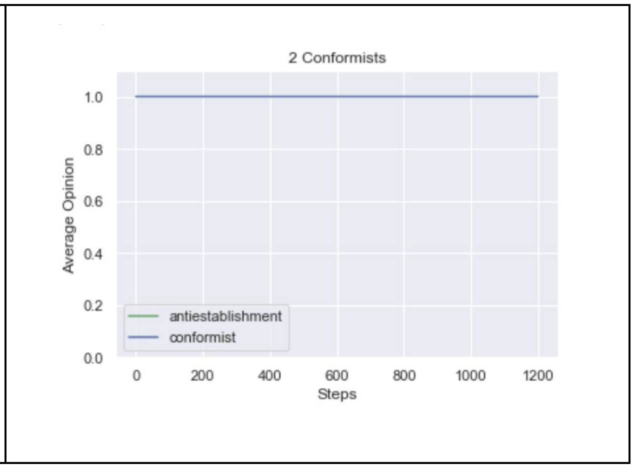
Table 1.1

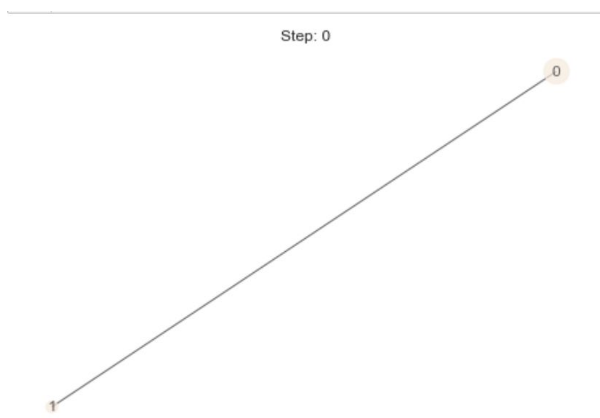
In both Table 1.1 and Table 1.0 when the probability of antiestablishment is one both Barabasi and Walts-stargaze show that the trait would persist. However, with Walts-stargaze we can see a greater amplitude i.e the divergence of average opinion from a one-time step to another is high while in Barabasi it is somehow stable. We can also notice that at the Barabasi graph the antiestablishment opinion tends to increase at the 1200 time step when probability in less than one unlike in the Walts-stargaze, thus we can say that in Barabasi antiestablishment trait tends to be more popular over time.

Having two nodes the possible arrangements are as follows

- 2 antiestablishment
- 1 conformist and 1 antiestablishment
- 2 conformist







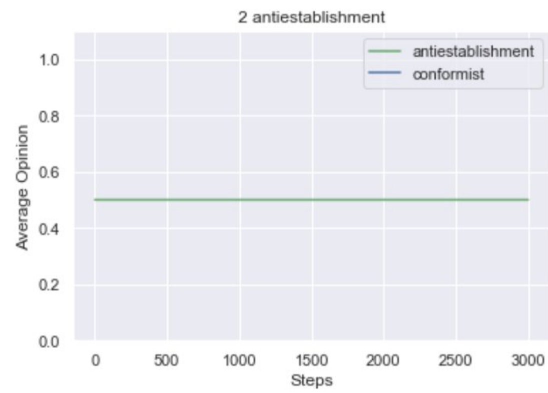
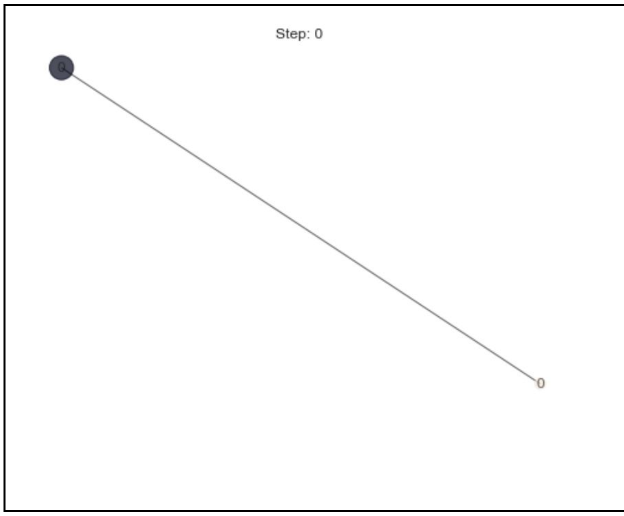


Table 1.3

The top two graphs on table 1.3 show the relationship: i.e the one on the top left shows network graph with 2 similar nodes in color indicating they are both conformist, the top right figure shows the average opinion which is 1 as they both agree. The two graphs at the bottom show the relationship between two antiestablishment, in this type of connection opinion are updated asynchronously thus there will only remain in a state of balance even if they regarding the starting opinion. Even if we run the simulation infinite time it is clear that convergence would never happen due to asynchronously update. If we would perform an experiment whereby we initialize the two nodes are initialized similarly then it would behave like a swinging pendulum whereby the only stable state is the state of balance, in that case at the trough.



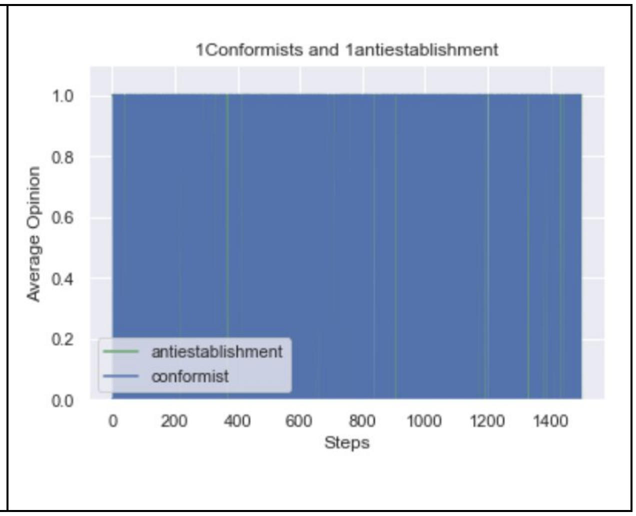


Table 1.4: The graphs shows the relationship between antiestablishment and comformist. Here there will be continuous oscillation as the conformist tries copying antiestablishment, antiestablishment diverge in terms of trait and the process is repeated an infinite number of times.

<u>Model-shortcomings</u>

The model can be improved in the following ways

- We could measure the strength of each relationship by adding weights

References

Juul, J. S., & Porter, M. A. (2019). Hipsters on networks: How a minority group of individuals can lead to an antiestablishment majority. *Physical Review E*, *99*(2). doi: 10.1103/physreve.99.022313