BT3107 Project Report: Simulating and Analyzing Voter Influence in a Social Graph

Name: Liu Yichuan

Matric No.: A0292159W

1. Initial Voting Outcome (Before Any Influence)

To model influence between voters, I created an undirected influence graph using an adjacency list. For each voter, I iterated through their listed friends and added a bidirectional edge if they shared three or more hobbies.

Each voter falls into one of three categories: supporting Party-A (vote = 1), supporting Party-B (vote = 2), or Neutral (vote = 3).I count the number of voters in each category using a simple aggregation.

Party-A: 1686 voters, Party-B: 1681 voters Neutral: 633 voters

Conclusion: Party-A leads on Day 1, before any influence is applied.

2. Vote Stabilization Over Time

To detect when the system stabilizes, I use a variable changes_today to track daily updates. The simulation continues until no changes occur. At the end of each day, vote counts for Party-A, Party-B, and Neutral are recorded to monitor the stabilization process.

Voting stabilized after 3 days.

Party-A: 2010 voters, Party-B: 1986 voters Neutral: 4 voters

Conclusion: Party-A leads after stabilization, before any influence is applied

Visualization: Graph 1 – Voting Stabilization Over Time (No Influence)

3. Scenario: Two Influencers Join on Day 0

I applied changes directly to the affected voters' initial votes on Day 0. After that, the usual influence simulation process is carried out, allowing only Neutral voters to update their decisions based on their influencing friends.

Voting stabilized after 3 days.

Party-A: 1970 voters, Party-B: 2029 voters Neutral: 1 voter.

Conclusion: Party-B leads after stabilization, after two influencers intervene: Graph2.

Visualization: *Graph 2 – Voting Stabilization Over Time (2 Influencers)*

4. Scenario: Party-A Hobby Influencer Strategy

I explored which specific **hobby-type group** would yield the greatest advantage for Party-A if targeted by an influencer. The influencer cannot vote but has the power to instantly convert all voters who are fans of a specific **type (1, 2, or 3)** within one **hobby category** (music, car, sports, movie, or food) to support Party-A on Day 0. I simulate the influence process for each of the **15 hobby-type combinations** and track final voting outcomes after stabilization.

Conclusion: The Optimal Hobby-Type Influencer for Party-A is: hobby_movie Type: 3

Party-A: 3669, Party-B: 331, Neutral: 0 Stabilized in 1 days.

Visualization:*Graph 3 – Voting Stabilization (Optimal Influencer)*

Sheet 1 – Optimal Hobby-Type Influencer (Sorted by Party-A Votes)

5. Exploratory Question: Who Are the Most Influential Voters?

To identify voters who are structurally well-positioned to influence others—especially Neutral voters—within the social graph,

I model the social connections using an undirected graph, where each voter is a node, and edges exist between friends who share ≥3 hobbies. To quantify influence using graph structure, I apply the spectral method learned in class:

• Construct the adjacency matrix A and degree matrix D

• Compute the graph Laplacian L = D - A

• Perform eigen-decomposition of L: L = V \Lambda V^T

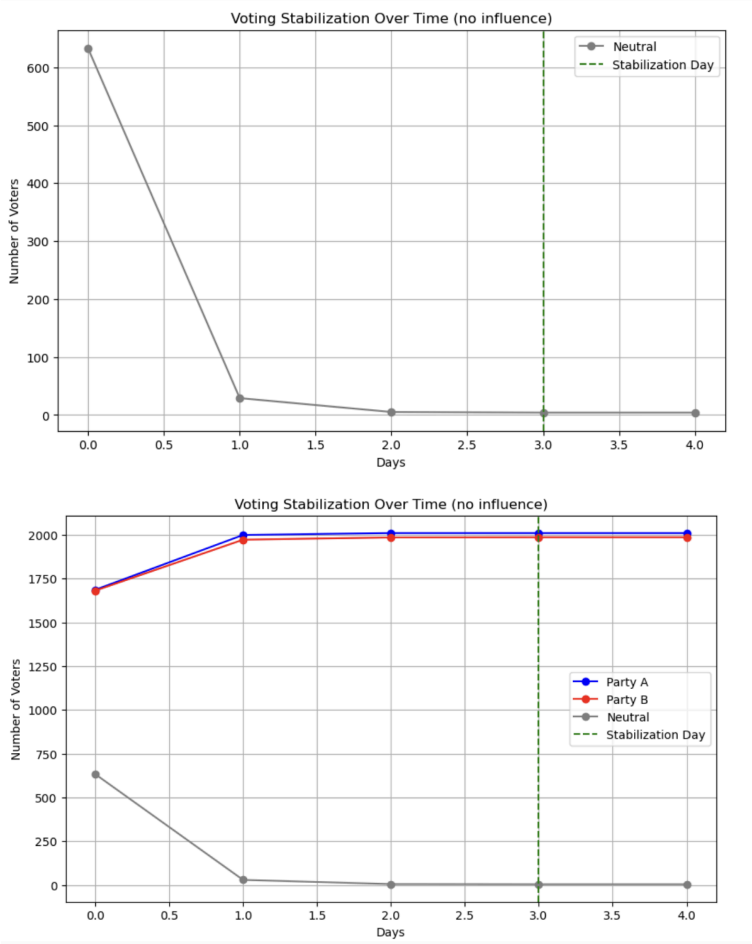
• Use L^k to estimate influence up to k-hop neighbors via: L^k x = V \Lambda^k V^T x

• I set k = 3, as it is the usual stabilization day. Then, I measure each node's total influence score as the sum of absolute values in their corresponding row of L^k

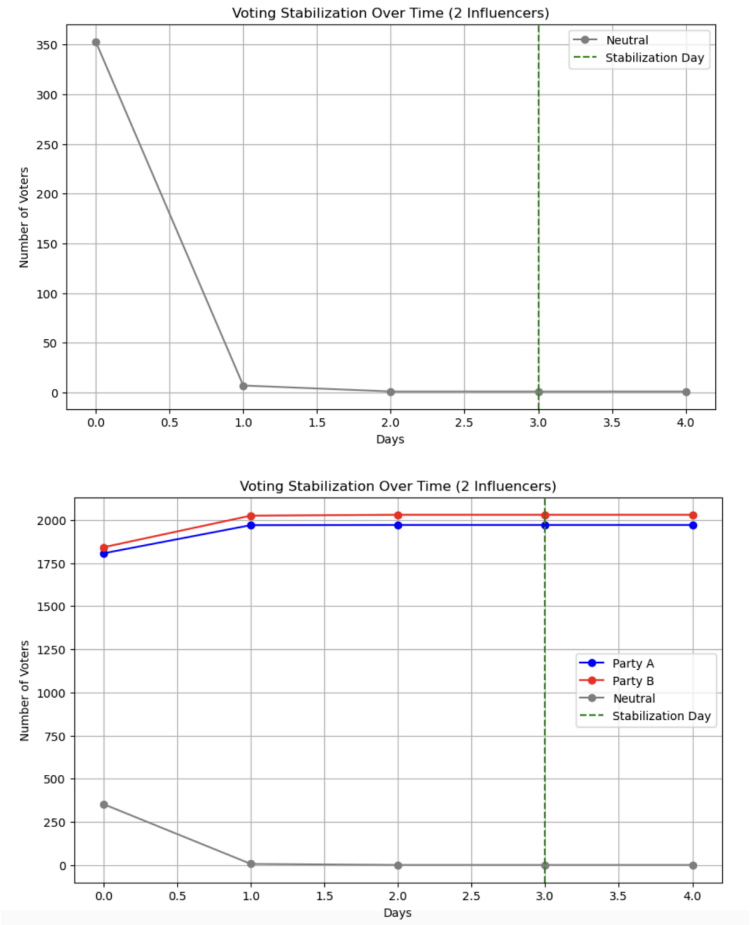
Conclusion: The top 10 voters with the highest spectral influence scores (i.e., those who have strong and far-reaching positions in the network)

Visualization: *Sheet2: Question5 - Voters with Top 10 Influence Score*

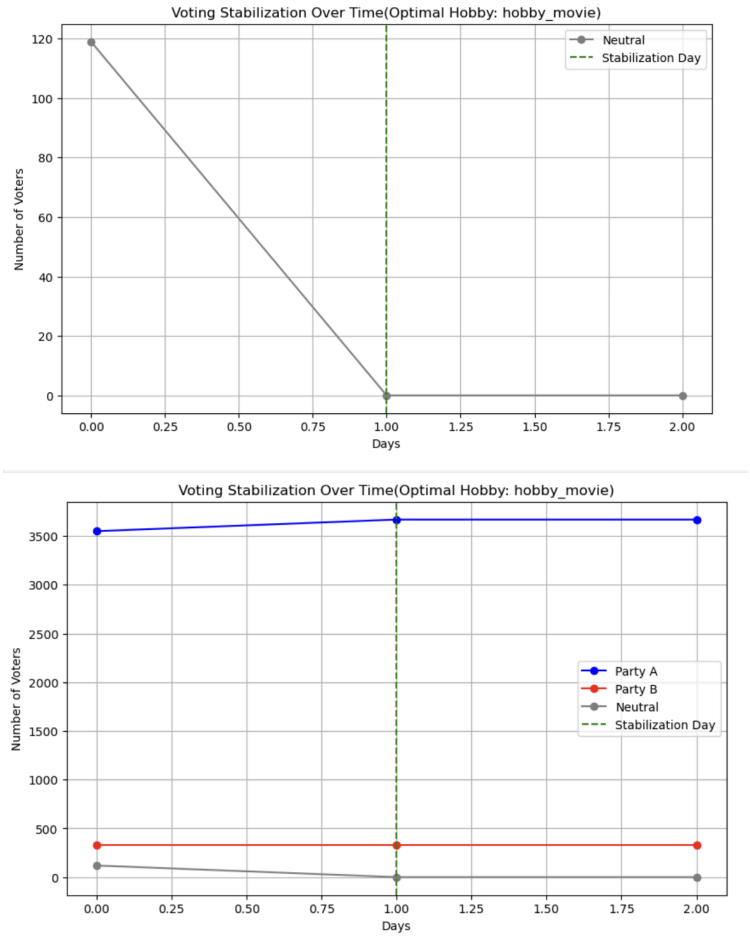
Appendix:



Graph 1: Question2 - Voting Stabilization Over Time (no influence)



Graph 2: Question3 - Voting Stabilization Over Time (2 influencers)



Graph 3: Question4 - Voting Stabilization Over Time (Optimal Hobby: hobby_movie)

Hobby	Type	Party-A	Party-B	Neutral	Days
Movie	**3**	**3669**	**331**	**0**	**2**
Food	3	3659	341	0	2
Sports	2	3649	351	0	2
Car	1	2875	1125	0	3
Music	2	2869	1130	1	3
Music	1	2868	1132	0	3
Car	2	2866	1134	0	3
Music	3	2865	1135	0	3
Car	3	2858	1142	0	2
Food	1	2386	1613	1	3
Sports	1	2353	1647	0	3
Sports	3	2346	1654	0	3
Movie	1	2339	1660	1	3
Food	2	2322	1678	0	4
Movie	2	2320	1680	0	3

Sheet 1: Question4 – Optimal Hobby-Type Influencer (Sorted by Party-A Voter Count)

Rank	Voter ID	Influence Score
1	3897	31,790,750.00
2	578	29,510,892.00
3	2309	27,888,650.00
4	947	27,431,194.00
5	3700	26,847,498.00
6	2466	26,732,816.00
7	810	26,452,476.00
8	3586	26,431,612.00
9	3896	26,368,918.00
10	3474	26,342,196.00

Sheet2: Question5 - Voters with Top 10 Influence Score