

# Detecting polarisation using cross-community social ties

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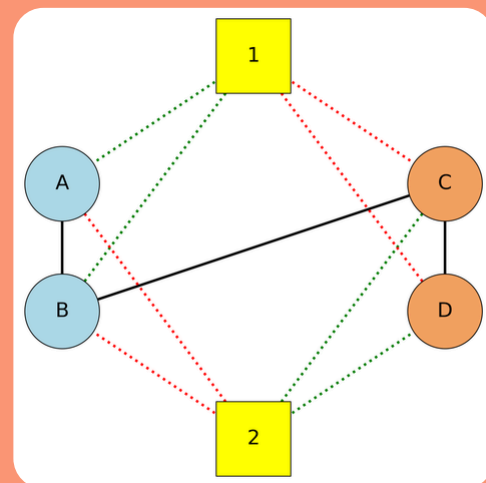


## 1. MOTIVATION

- **Polarisation** is rising in **online social networks**.
- This leads to real-world **distrust** and **conflict**.
- **Community structure** of networks may be an indicator of emerging polarisation [Girvan and Newman, 2002].
- The effect of **cross-community social ties** on polarisation has not been investigated.

## 2. BACKGROUND

- Networks as two-level graphs [Mephram et al., 2025]
  - Ideological (**political attitudes**)
  - Relational (**social interactions**)
- Polarisation measured on both dimensions



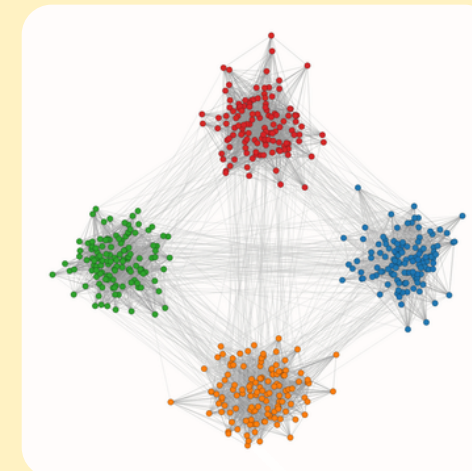
Toy example with 4 people (circles) and 2 issues (squares)

## 3. RESEARCH QUESTION

To what extent does the fraction of **cross-community social ties** influence the level of **polarisation** in a network?

## 4. APPROACH

### Synthetic network generation



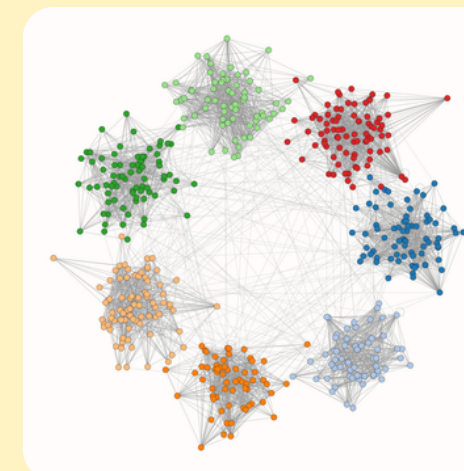
#### Stochastic Block Model (SBM)

[Holland et al., 1983]

- Fixed number of communities and community size
- **Homogeneous** community structure → **not realistic**
- $\alpha$  - Cross-community tie ratio

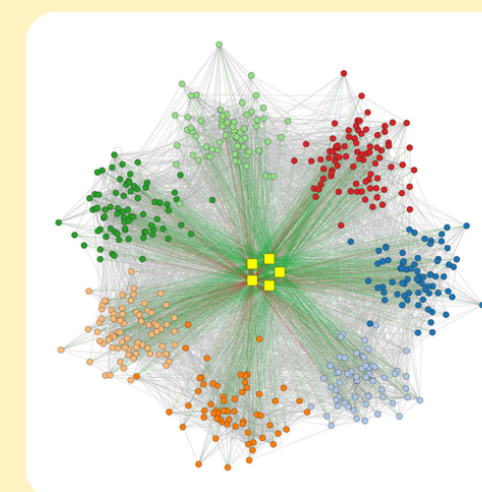
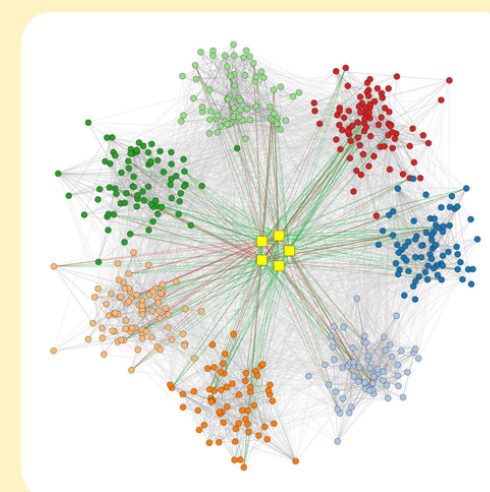
#### Lancichinetti–Fortunato–Radicchi (LFR) [Lancichinetti et al., 2008]

- Community sizes and node degrees follow **power law distributions**
- **Heterogeneous** community structure → **more realistic**
- $\mu$  - Cross-community mixing



### Network evolution

- **Opinion initialisation:** A few people in each community are assigned opinions on issues.
- **Opinion diffusion:** Opinions spread according to the **Linear Threshold Model** [Kempe et al., 2003].
- **Homophilous rewiring:** People can cut ties with friends they disagree with and form new ties.



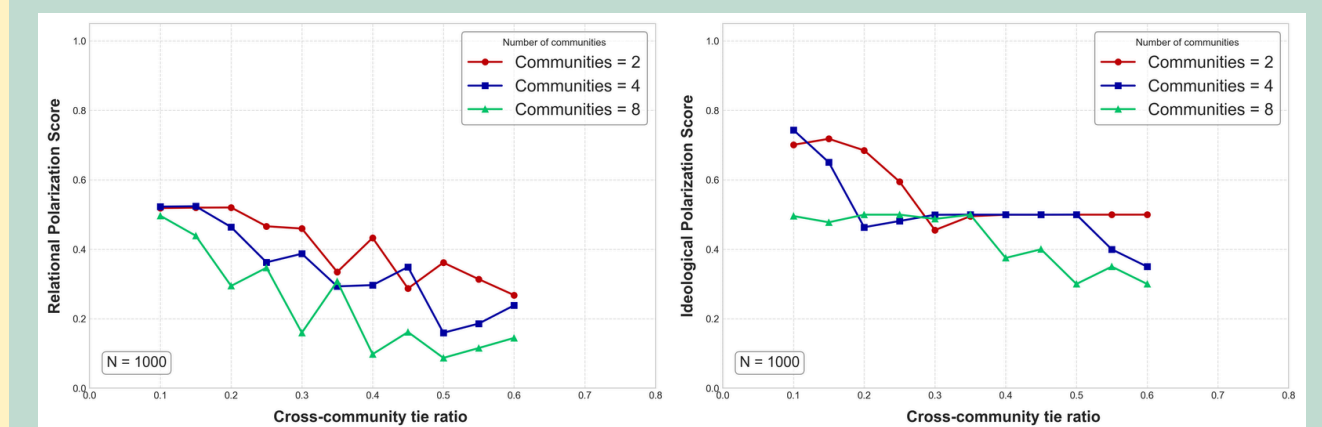
Network before and after running the network evolution algorithm

## 5. EXPERIMENTS

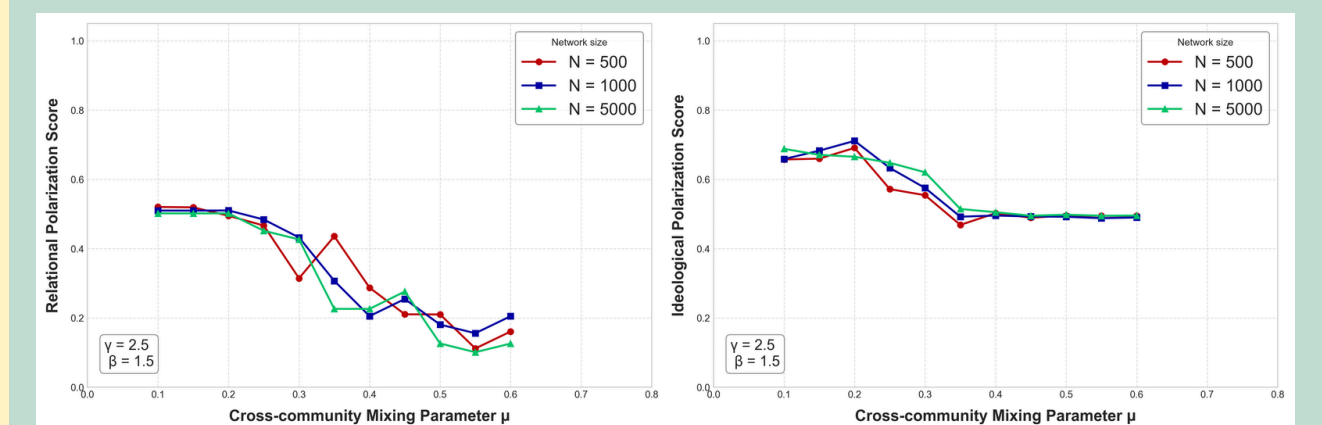
### Setup

- **SBM:**  $c \in \{2, 4, 8\}$ ;  $\alpha \in \{0.1, 0.15, \dots, 0.6\}$
- **LFR:**  $\gamma=2.5$ ,  $\beta=1.5$ ,  $\mu \in \{0.1, 0.15, \dots, 0.6\}$
- **20 iterations** per configuration

### Results



Relational and Ideological polarisation in SBM Networks



Relational and Ideological polarisation in LFR Networks

### Key findings:

- **More cross-community ties => less polarisation**
- Decline is smoother in **LFR** networks
- Polarisation **decreases faster** with **more communities**

## 6. FUTURE WORK

- Working on **real datasets**
- More complex **opinion dynamics models**

### References

[Girvan and Newman, 2002] Girvan, M., & Newman, M. E. J. (2002). Community structure in social and biological networks. Proceedings of the National Academy of Sciences, 99(12), 7821–7826. <https://doi.org/10.1073/pnas.122653799>  
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[Kempe et al., 2003] Kempe, D., Kleinberg, J., & Tardos, É. (2003). Maximizing the spread of influence through a social network. Proceedings of the Ninth ACM SIGKDD International Conference on Knowledge Discovery and Data Mining, KDD '03, 137–146. <https://doi.org/10.1145/956750.956769>  
[Lancichinetti et al., 2008] Lancichinetti, A., Fortunato, S., & Radicchi, F. (2008). Benchmark graphs for testing community detection algorithms. Physical Review E, 78(4), 046110. <https://doi.org/10.1103/PhysRevE.78.046110>  
[Mephram et al., 2025] Mephram, K., Vörös, A., & Stadtfeld, C. (2025). Network polarization: The study of political attitudes and social ties as dynamic multilevel networks. Network Science, 13, e7. <https://doi.org/10.1017/nws.2025.2>