



NETWORKS, AGENTS, AND SOCIAL CONTAGION

Data Science Bootcamp

PRESENTED BY

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Feat. work with assistance from Nicholas Johnson, Christina Ting, and Derek Tucker.



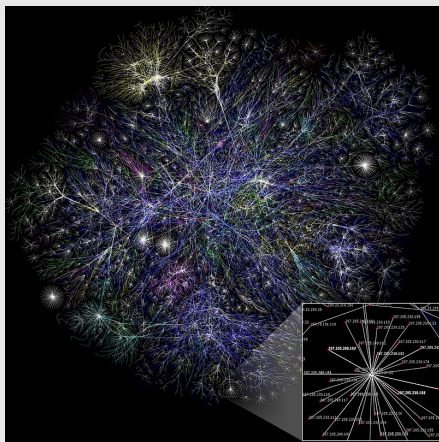
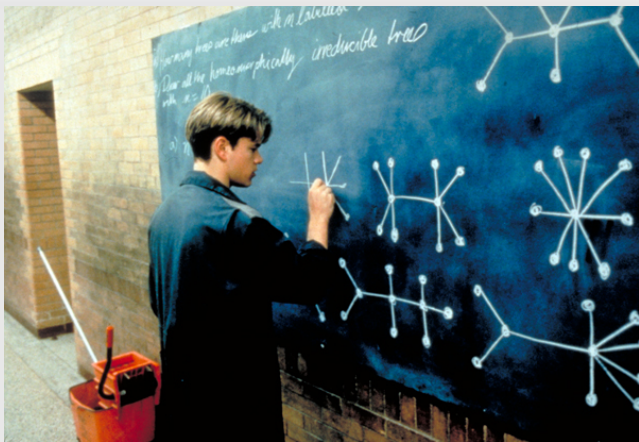
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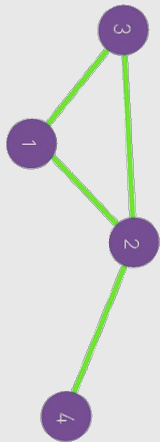
Micro-intro 1:

NETWORK SCIENCE

NETWORKS OR GRAPHS?



NETWORKS OR GRAPHS?



graph theory



network science

graph
vertex
edge

refers to mathematical
representation

network
node
link

refers to real system

NETWORKS OR GRAPHS?



{network, node, link}

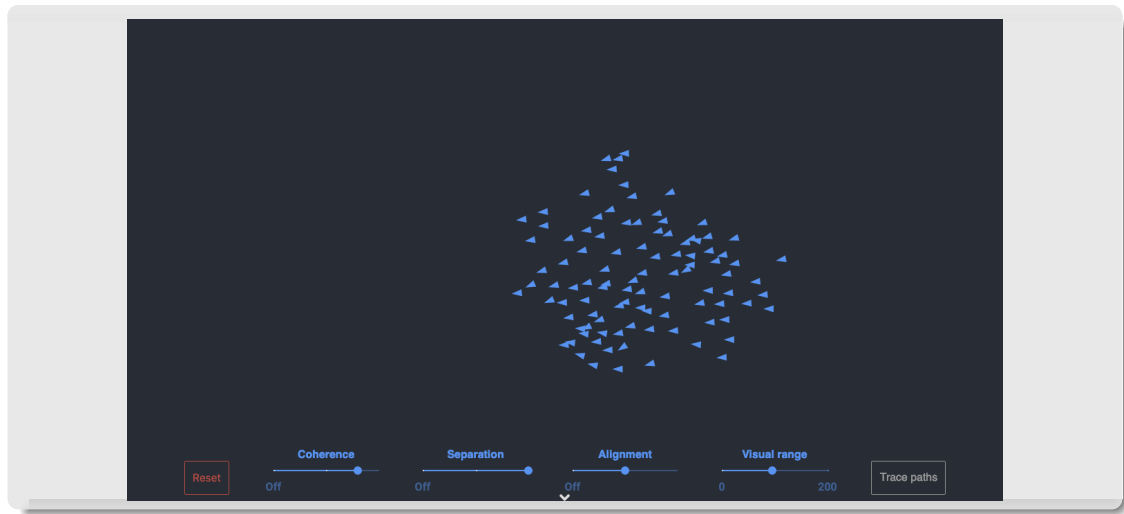


{graph, vertex, edge}



Micro-intro 2:

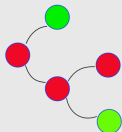
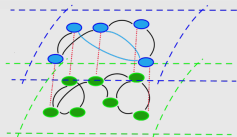
AGENT-BASED MODELING





Feature Presentation:

A PROJECTED NETWORK MODEL OF ONLINE DISINFORMATION CASCADES



- Begin with a network representing “offline” relationships.
- Project some fraction p of nodes onto a secondary “online” plane.
- Propagate social contagion through the network.

Contagion States:

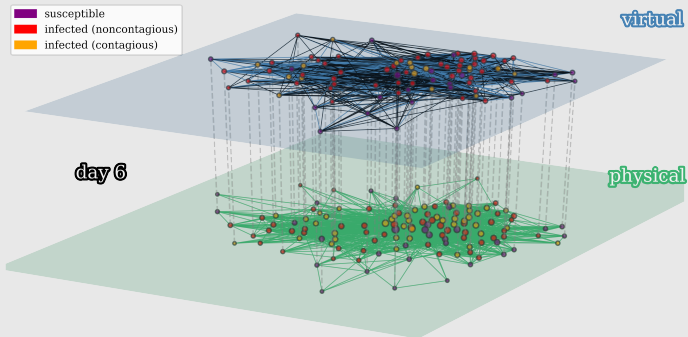
S - susceptible

I - infected

IC - infected & contagious



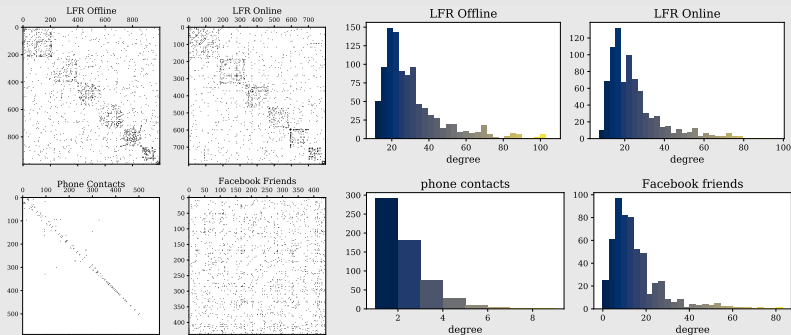
An example contagion in action





Two petri dishes

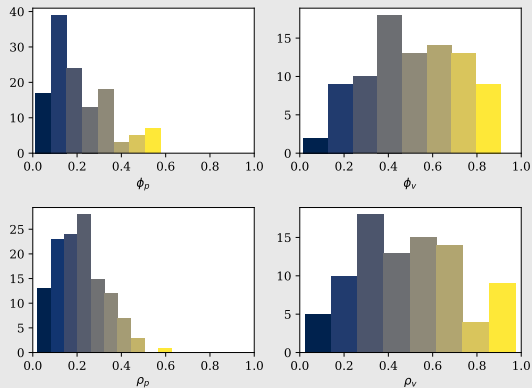
- Synthetic network with social network structure (kind of) [3]
 - Random subset of nodes in online layer.
- Observed networks from Copenhagen interactions study [5]
 - SMS, calls, and Facebook friendship data





Set the parameters.

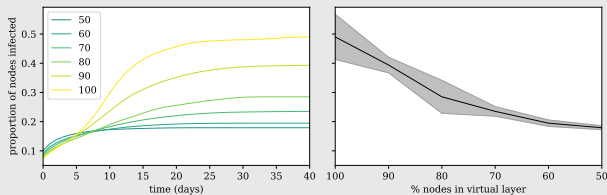
$$\phi_v, \rho_v, \phi_p, \rho_p \sim \text{Beta}(\alpha_{xy}, \beta_{xy})$$



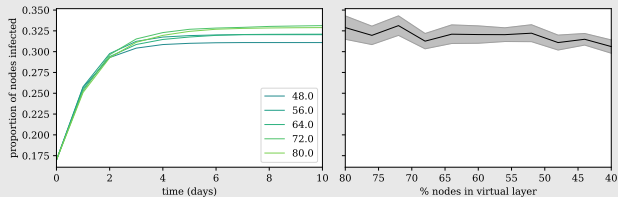


The #DeleteFacebook test

LFR:



Copenhagen:

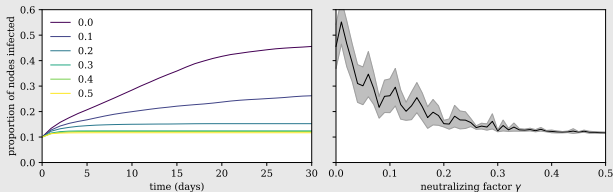




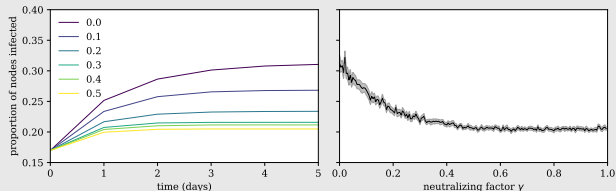
The “fact-check” test

$$\phi_\gamma = \phi + \gamma(1 - \phi)$$

LFR:



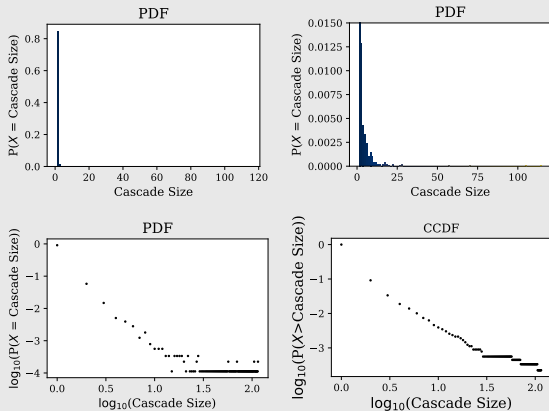
Copenhagen:



NOW FOR SOME ACTUAL DATA!



- Dataset of misinformative Whatsapp posts surrounding the 2019 election in India [4]





Other future directions

- ⬡ There is a number of ways to refine this model & experimentation.
 - ⬡ Non-random social media adoption.
 - ⬡ Assimilation of additional data.
 - ⬡ Allow agents to “report” contagious users.
- ⬡ Formation and reinforcement of narratives.



- [1] Eater, B. (2020). Boids algorithm demonstration. <https://github.com/beneater/boids>.
- [2] Klein, B. (2020). matplotlib-multilayer-network. <https://github.com/jkbren/matplotlib-multilayer-network>.
- [3] Lancichinetti, A., Fortunato, S., and Radicchi, F. (2008). Benchmark graphs for testing community detection algorithms. *Physical review E*, 78(4):046110.
- [4] Reis, J. C., Melo, P., Garimella, K., Almeida, J. M., Eckles, D., and Benevenuto, F. (2020). A dataset of fact-checked images shared on whatsapp during the brazilian and indian elections. In *Proceedings of the International AAAI Conference on Web and Social Media*, volume 14, pages 903–908.
- [5] Sapiezynski, P., Stopczynski, A., Lassen, D. D., and Lehmann, S. (2019). Interaction data from the copenhagen networks study. *Scientific Data*, 6(1):1–10.