Lightning Talks I

★ **Gill Grindstaff** (UT Austin)
Data analysis in the space of phylogenetic trees

★ **Ana Rios** (UACM)
A metabolic network for plastic disposals in Mexico

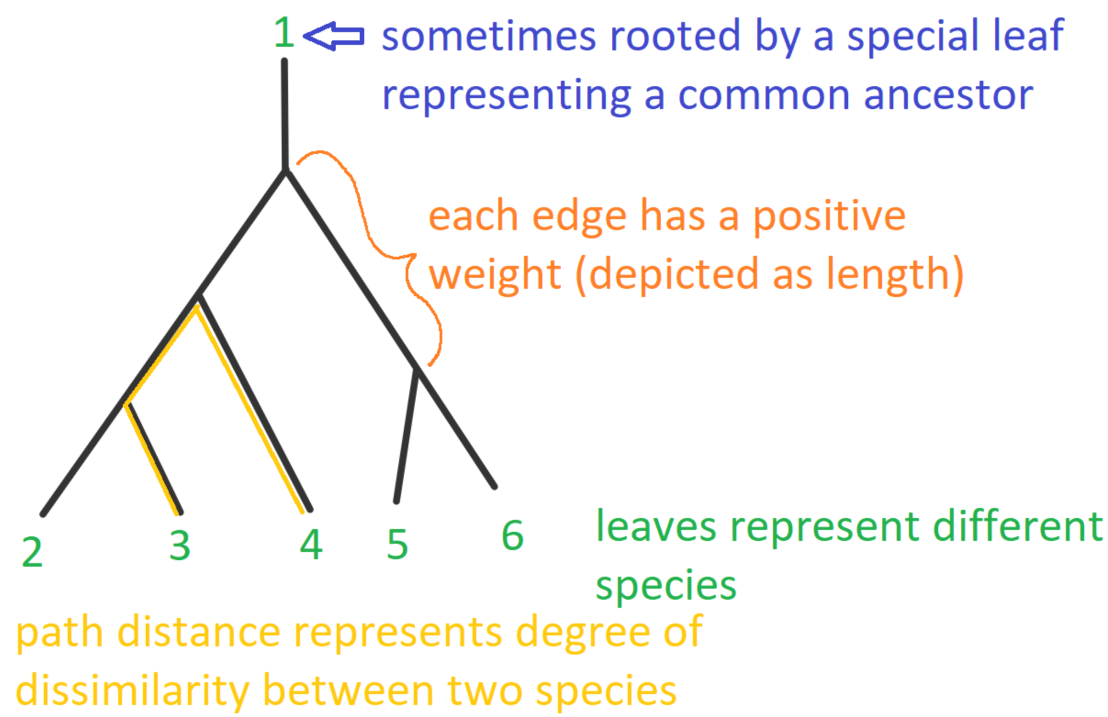
★ **Allison Morgan** (CU Boulder)
Faculty hiring and the spread of scientific ideas

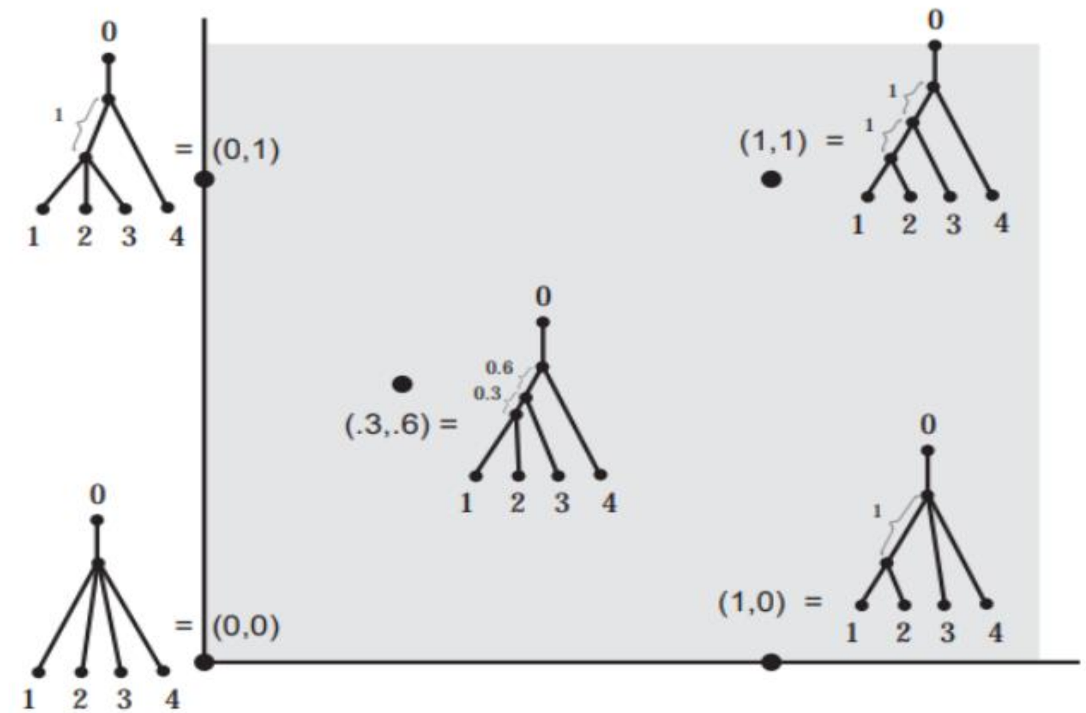
★ **Samin Aref** (Max Planck)
Analyzing networks of political collaboration

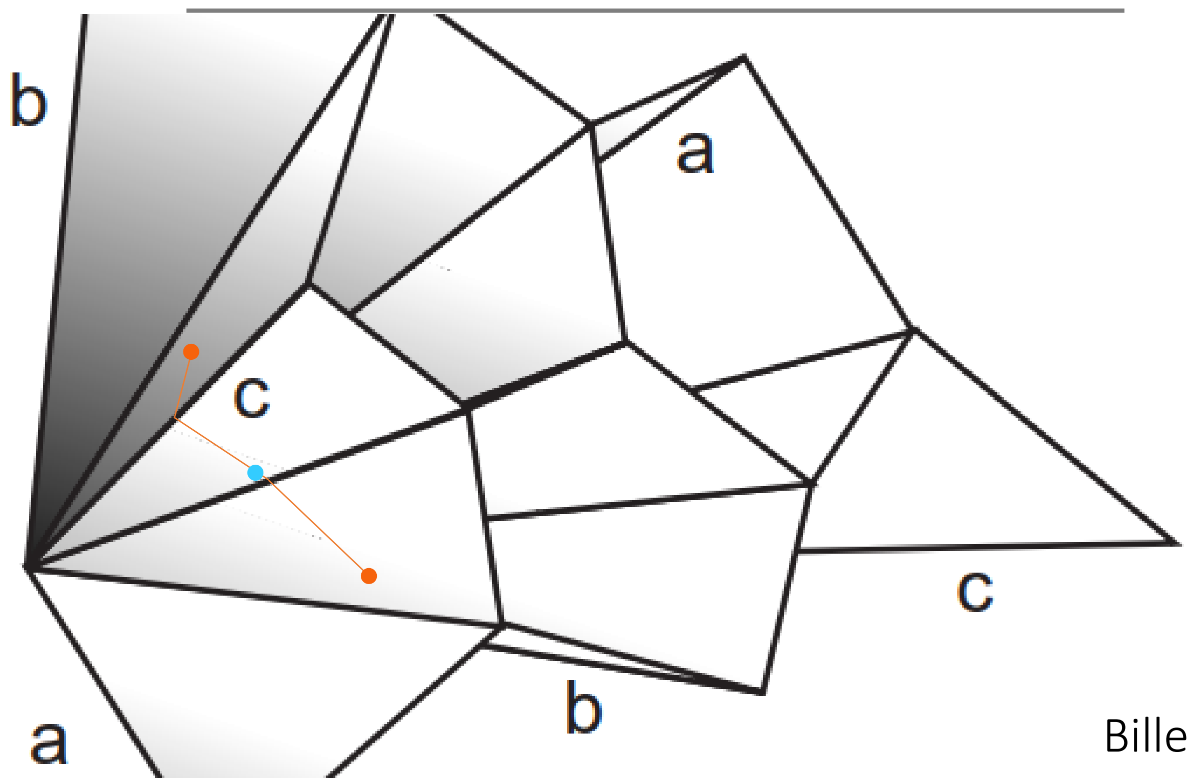
Data Analysis in the Space of Phylogenetic Trees

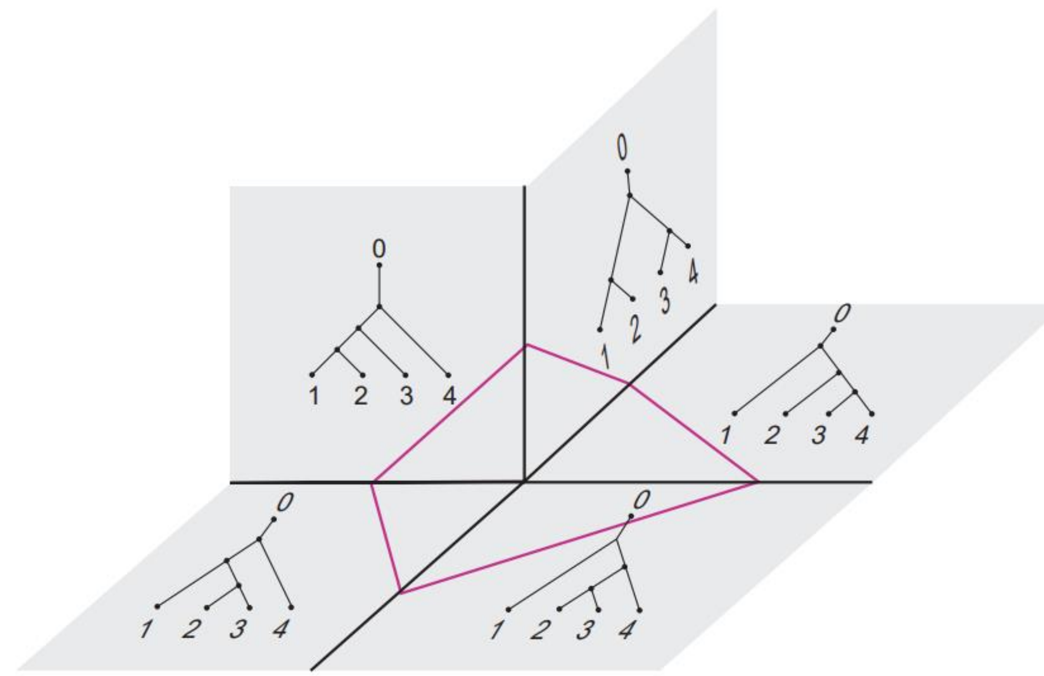
Gill Grindstaff

University of Texas at Austin
Mathematics

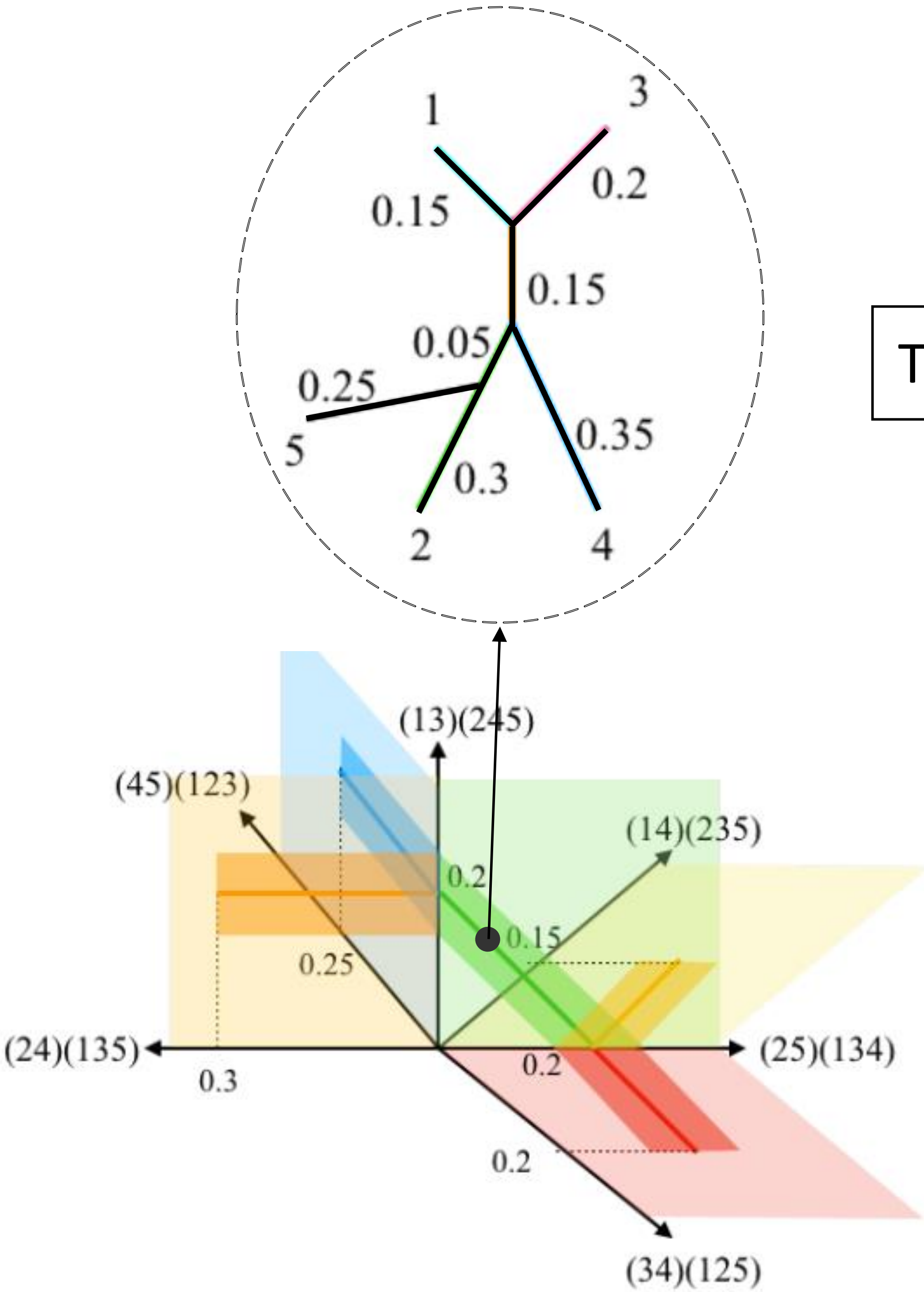


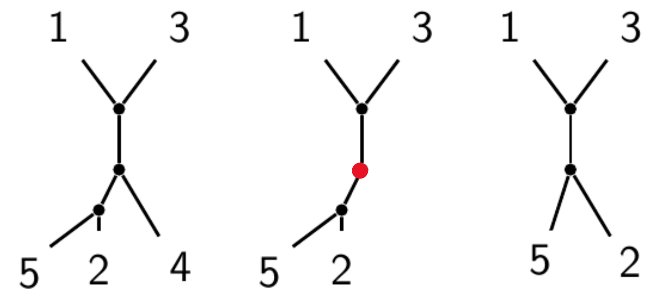




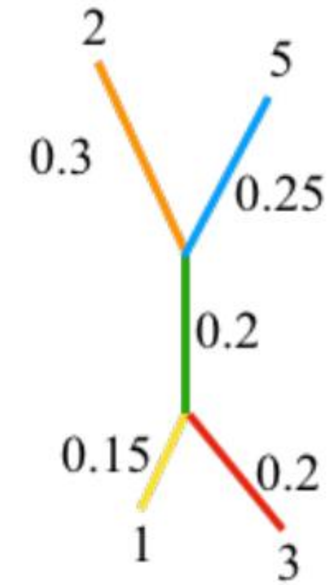


Billera, Holmes, Vogtmann: *Geometry in the space of phylogenetic trees*





Tree dimensionality reduction



Grindstaff, Owen 2019

- Supertree construction
- Measure compatibility of tree fragments
- Search extension space

UACM
Universidad Autónoma de la Ciudad de México
Nada humano me es ajeno

"A Metabolic Network of a Circular Economy for Plastic Disposals in Mexico"

Graphs & Networks Workshop

July 10, 2020

Ana Belén Ríos Carmona
abrios2303@gmail.com
Fernando Ramírez Alatriste

Plastic Waste

What is the main problem?

Packaging plastic waste

Is circular economy a solution?

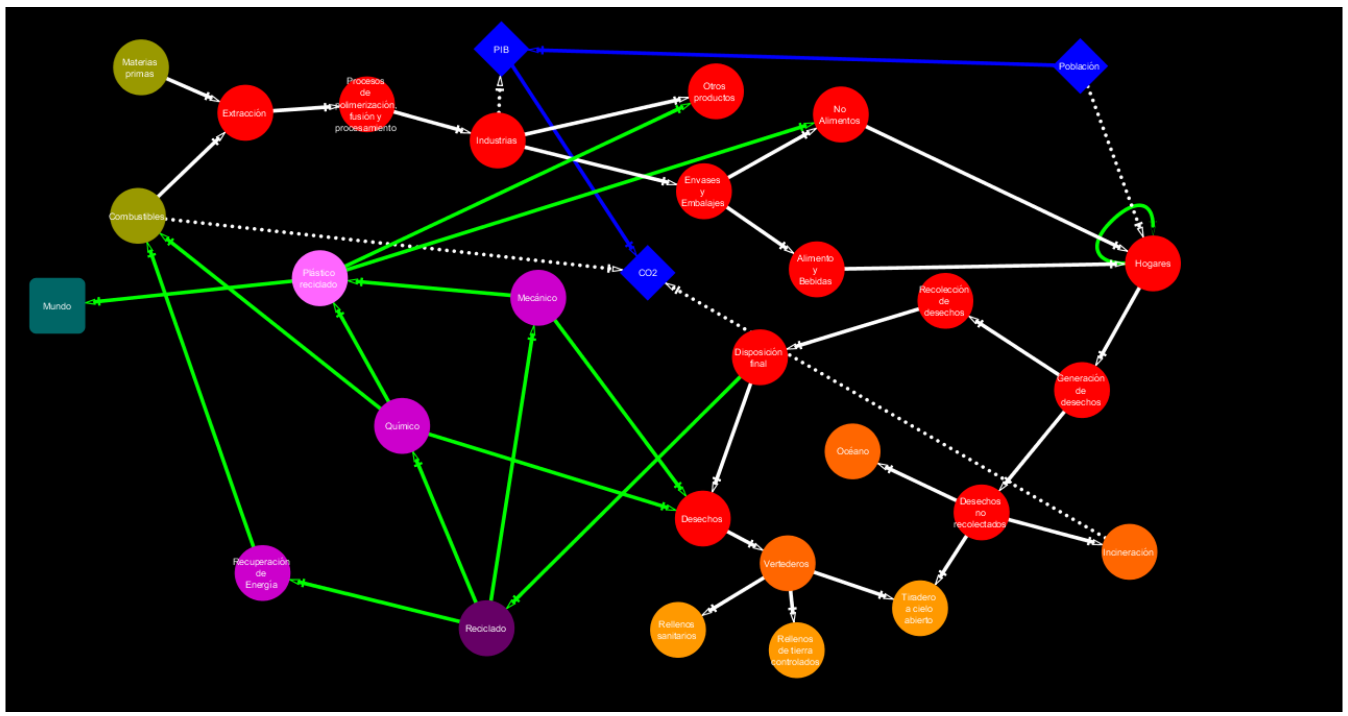
Proposal: System Thinking

Metabolic Network

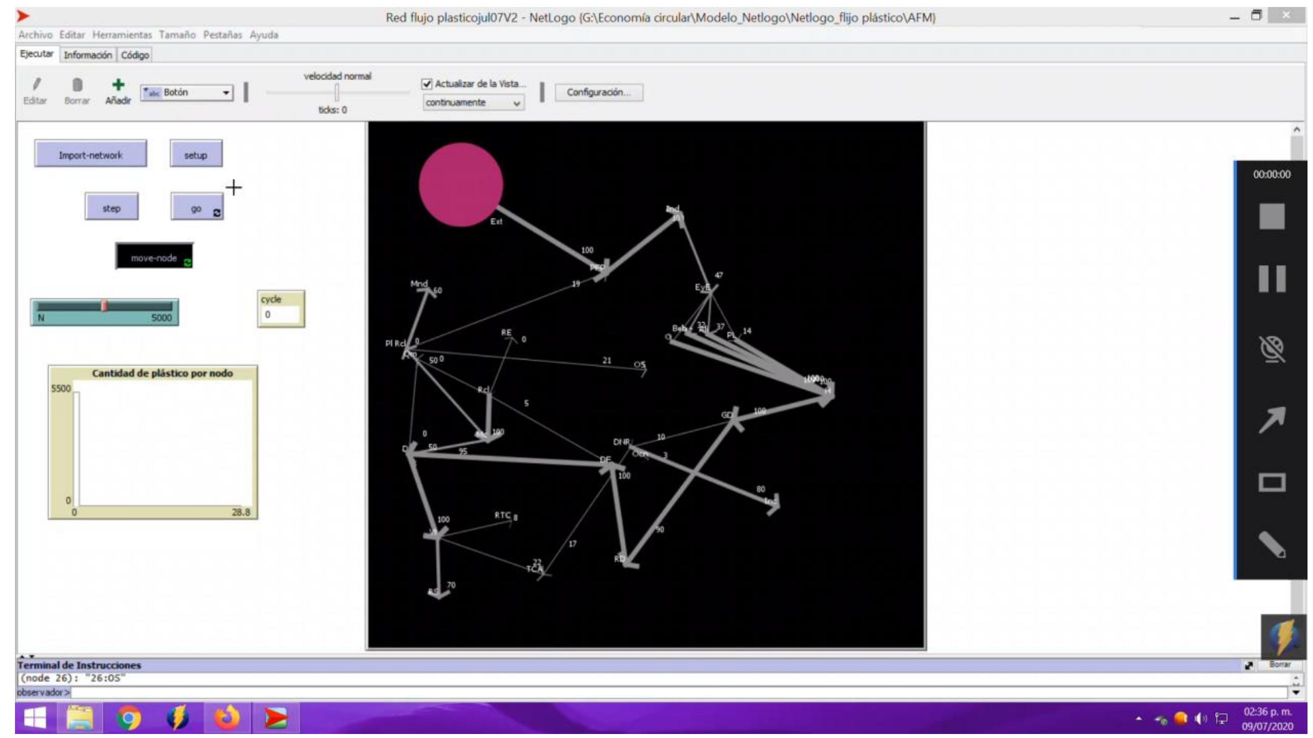
- Social system
- Economic system
- Enviromental system

Matter Flux Analysis (MFA) applying an agent- based model

Metabolic Network



Matter Flux Analysis



https://vimeo.com/436908555

Prestige drives epistemic inequality in the diffusion of scientific ideas

Allison C. Morgan[1*], Dimitrios J. Economou[1], Samuel F. Way[1] and Aaron Clauset[1,2,3]

EPJ Data Science (2018). Link

Faculty hiring and the spread of scientific ideas

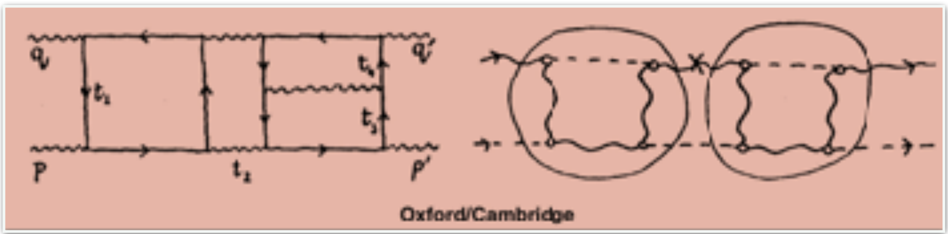
Allison Morgan, Dimitrios Economou, Samuel Way, Aaron Clauset

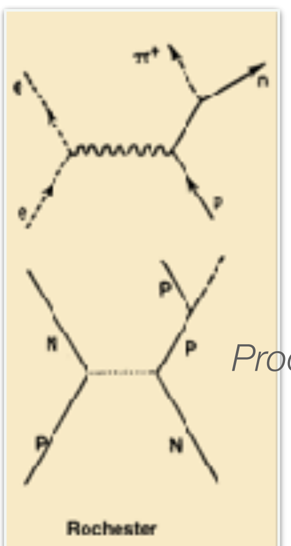
Graphs and Networks, July 10th 2020

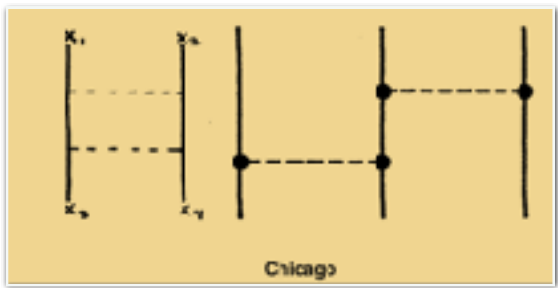
Email: allison.morgan@colorado.edu
Twitter: @alliecmorgan

University of Colorado **Boulder**

NSF





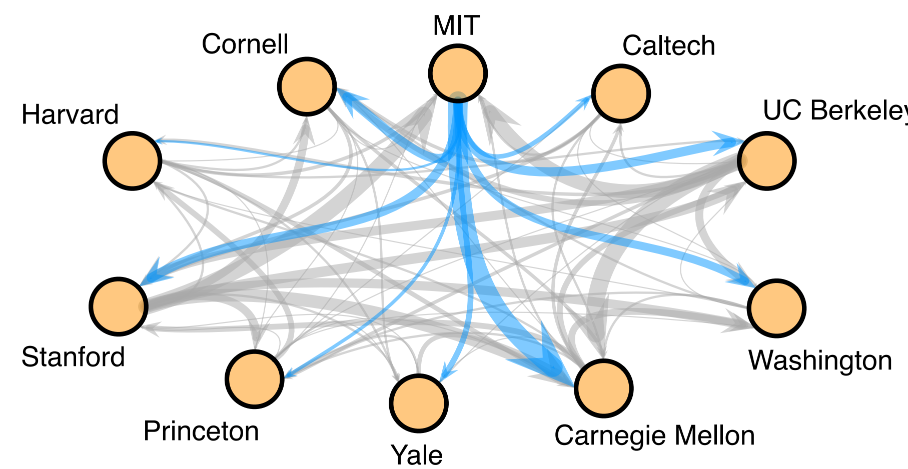


American Scientist (2005)
Proc. 11th Conf. on Web and Social Media (2017)

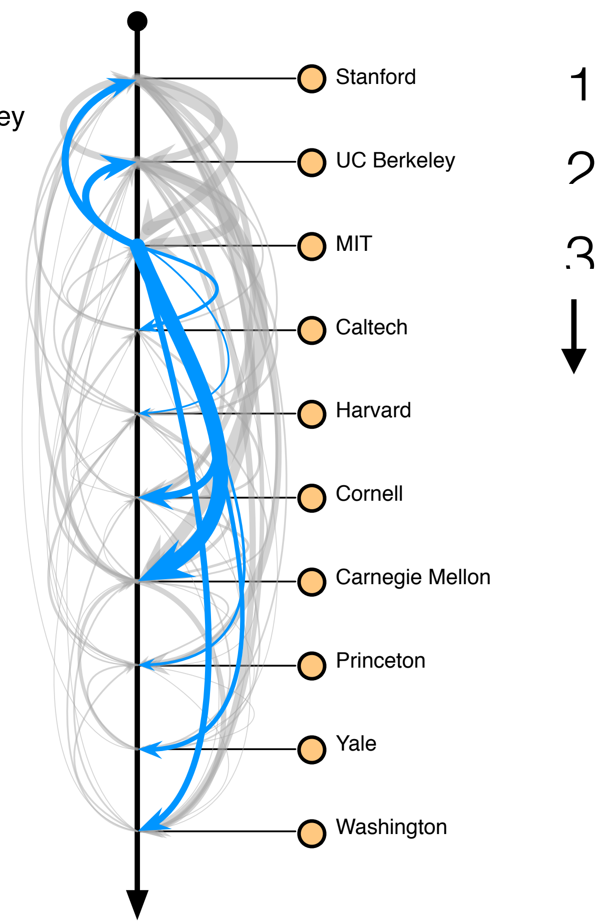
W. Lamb, J. Wheeler, A. Pais,
R. Feynman, H. Feshbach, J. Schwinger

Scientific ideas spread through hiring

Faculty hiring networks: Dramatic inequality in PhD production



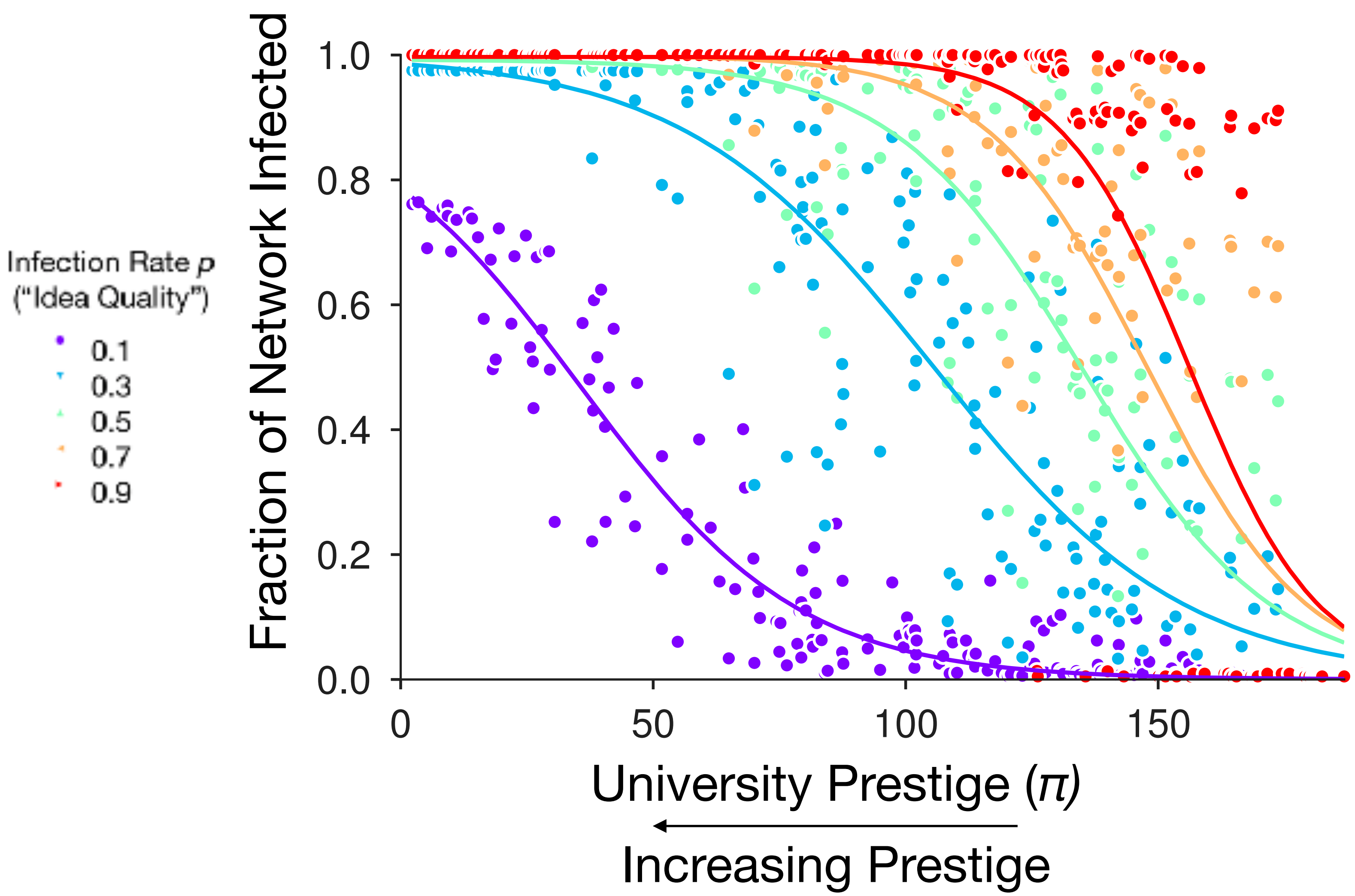
Sci. Adv. (2015) Link



Approach: Simulate the spread of ideas, varying which university generates an idea and its quality

More wonderful visualizations from McKenzie Weller (Link)

Does the structure of the faculty hiring network affect the spread of ideas?



Prestige drives epistemic inequality in the diffusion of scientific ideas

Allison C. Morgan, Dimitrios J. Economou, Samuel F. Way and Aaron Clauset

EPJ Data Science (2018). Link

Takeaways: Ideas spread in academia via faculty hiring. The structure of this network can privilege elite institutions.

Incentivizing many incremental ideas will tend promote the visibility of prestigious researchers

Caveats: Model assumes quality is independent of institution and hiring decisions. Could we test this?

Thought experiments: What if hiring was random? What if the lowest ranked universities chose first (NBA)? What other non-meritocratic mechanisms might be at play?

Analyzing Signed Networks of Political Collaboration based on Balance Theory

Samin Aref – Max Planck Institute for Demographic Research

House of Representatives

Senate

Research Question:

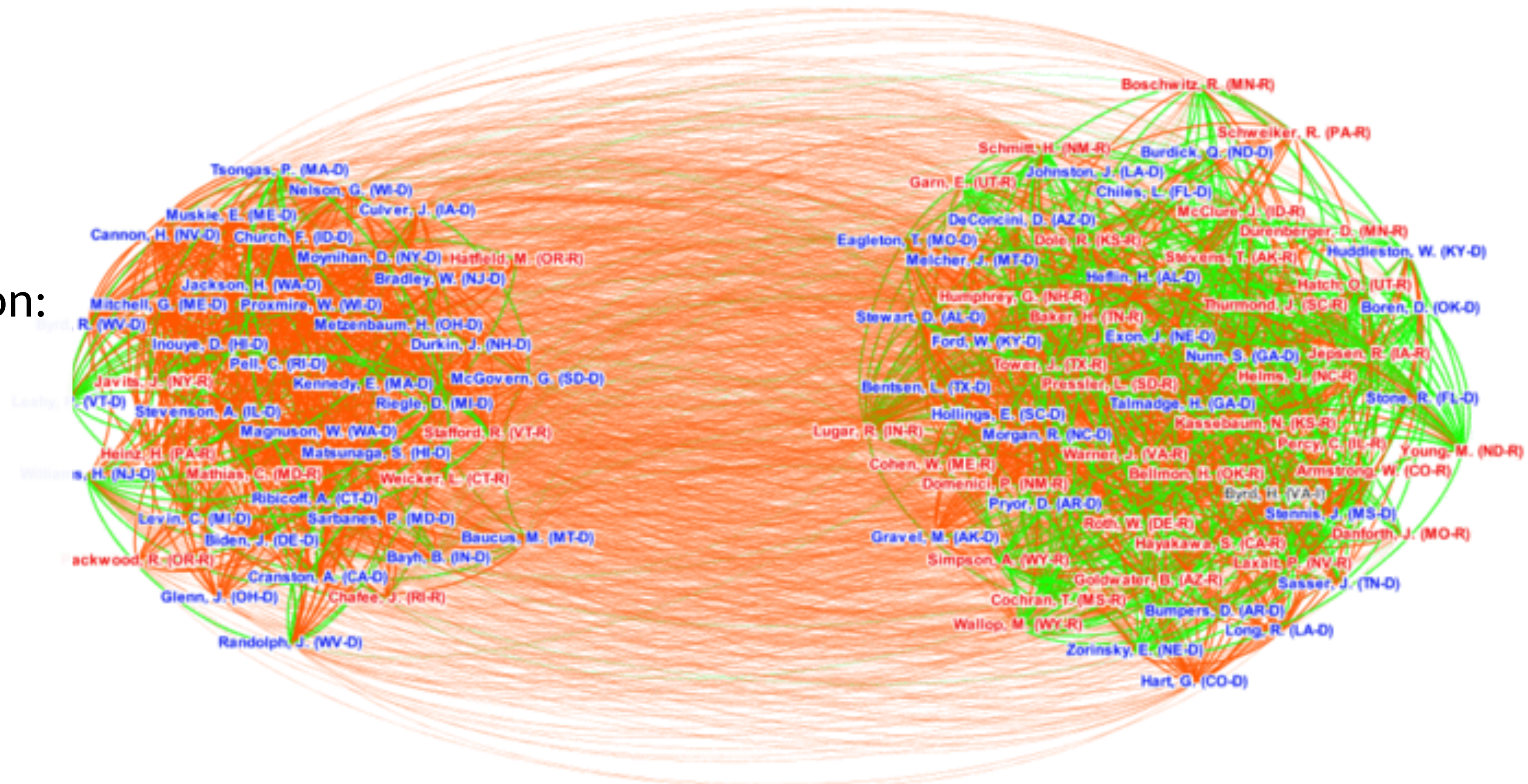
Why is Congress so ineffective at passing legislation?

Samin Aref and Zachary Neal - Analyzing signed networks of political collaboration - Code and data are publicly available

Open access full-text ->

1979

We use networks of positive and negative collaboration ties between legislators.



Node colors=party affiliation:

- Republican
- Democrat

Edge colors:

- Collaboration
- Lack of collaboration

MICHIGAN STATE UNIVERSITY

MAX PLANCK INSTITUTE FOR DEMOGRAPHIC RESEARCH

Samin Aref and Zachary Neal - Analyzing signed networks of political collaboration - Code and data are publicly available

Open access full-text ->

Lightning Talks II

- **R. Janaki** (University of Madras)
  Learning to be modular: Connection topology in the brain
- **Pepi Pandiloski** (UChicago)
  Cooperation in small worlds
- **Juniper Lovato** (University of Vermont)
  Distributed consent in social networks
- **Rebecca Burkholz** (Harvard)
  International crop trade networks: Shocks and cascades

GRAPHS & NETWORKS

July 10, 2020

LEARNING TO BE MODULAR

Dynamics of connection topology in the brain

R. Janaki [1,2]

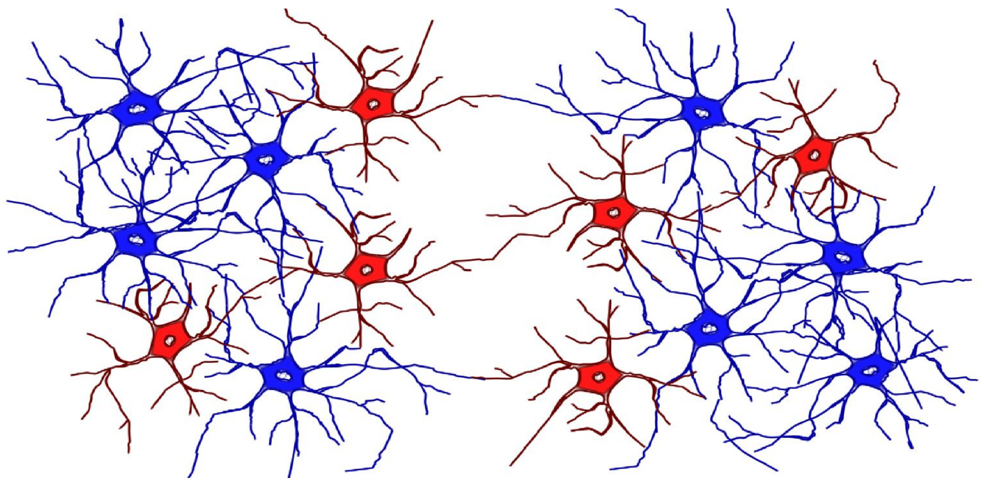
Sitabhra Sinha [2]

[1]Department of Physics, University of Madras, Chennai, India

[2]The Institute of Mathematical Sciences, Chennai, India

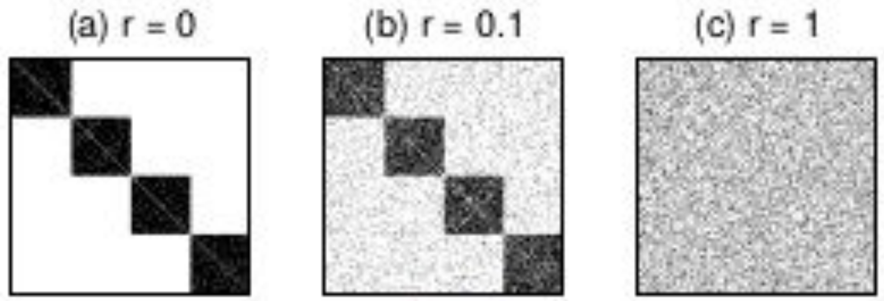
Balancing Excitation & Inhibition: The advantage of modularity

Modular organization of neuronal connectivity
Dense connections within each module and sparse connectivity between modules

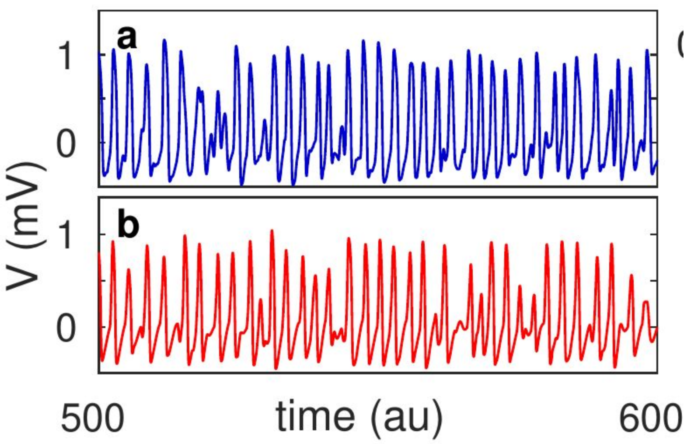


Modular network of Fitzhugh-Nagumo model neurons

r : ratio of inter- to intra-modular connection density

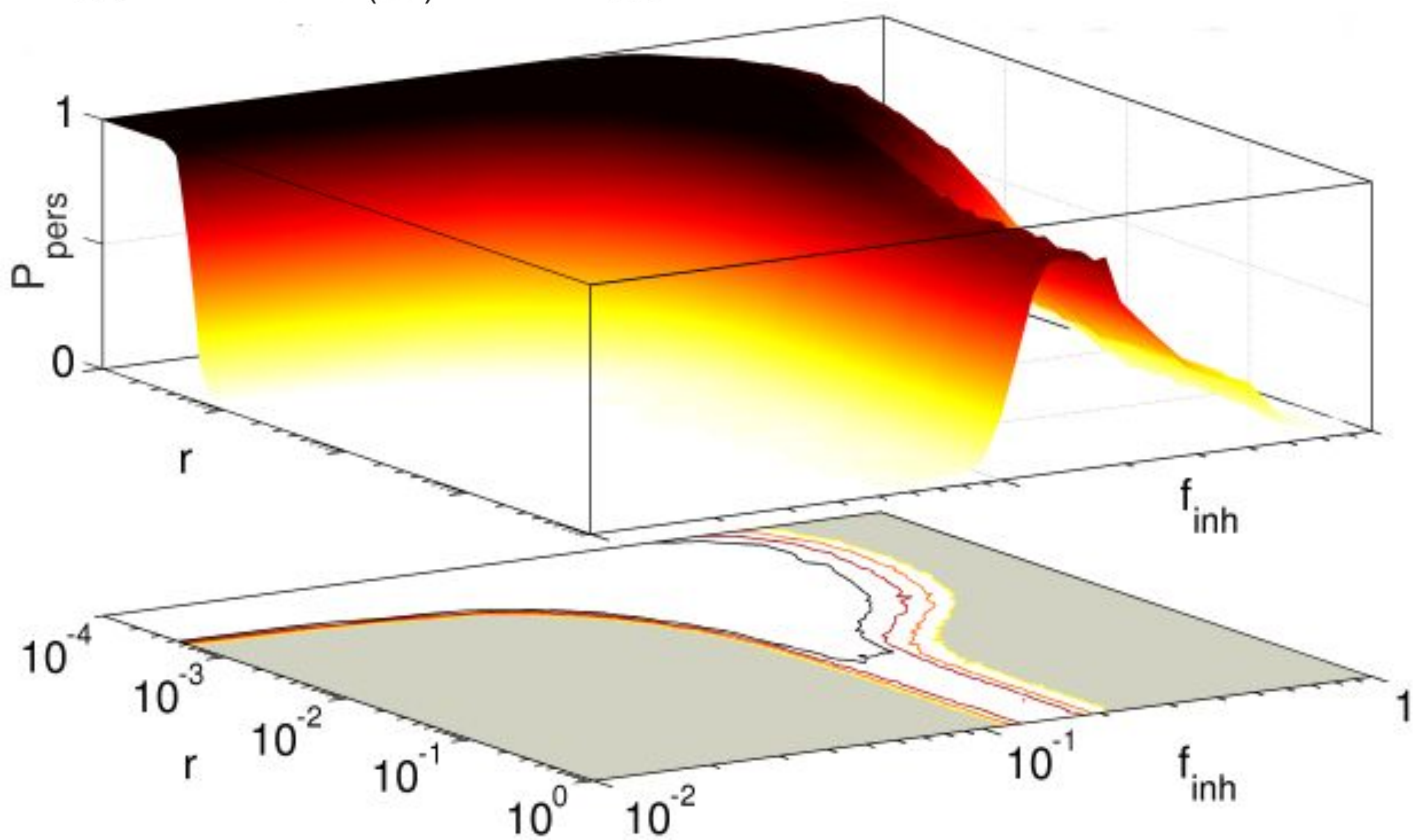


N Pradhan, S Dasgupta and S Sinha, EPL **94** (2011)



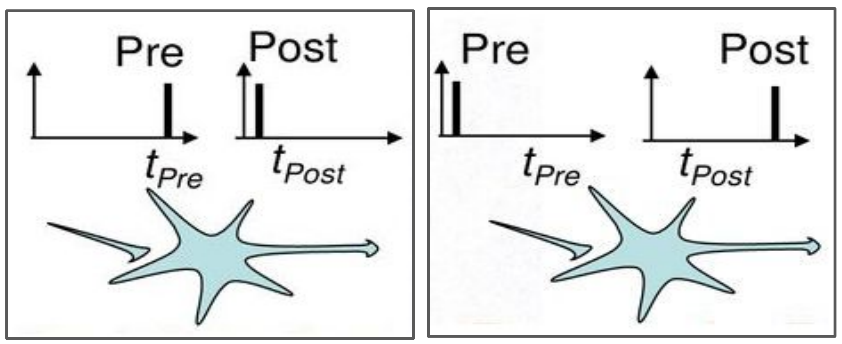
P_{pers}: probability of persistent activity

f_{inh} : fraction of inhibitory neurons



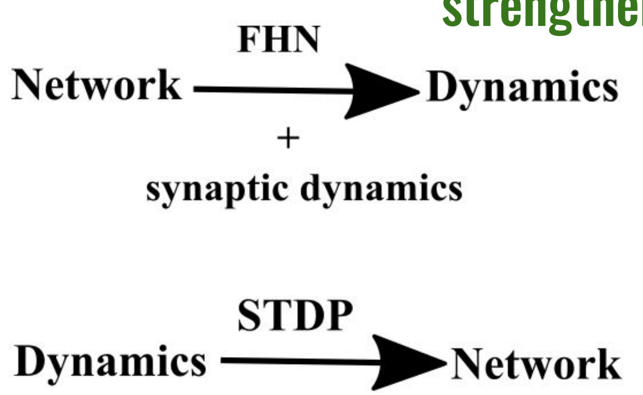
How do these modular networks arise?

Learning through Spike Timing Dependent Plasticity (STDP)



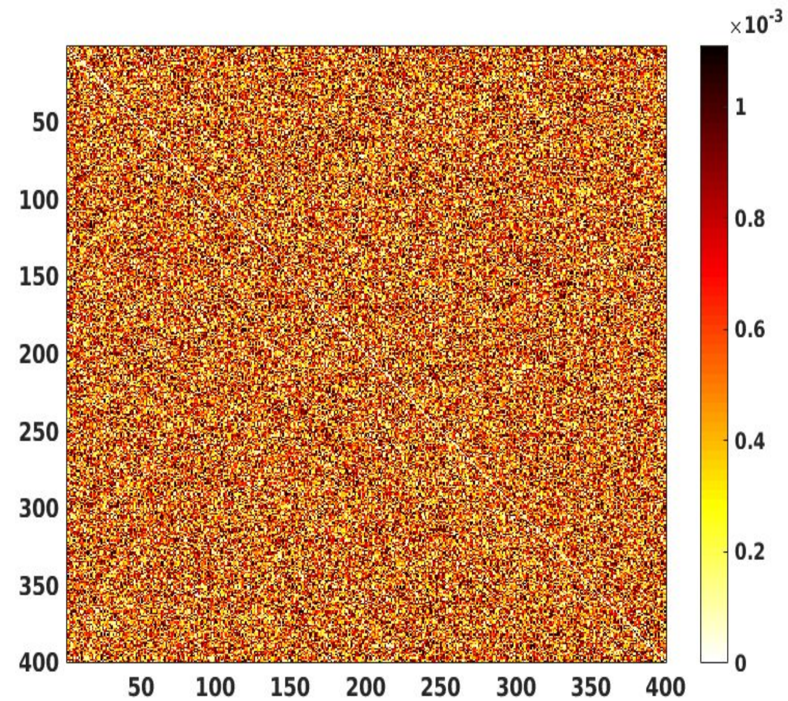
Pre follows Post : synapse weakens

Pre precedes Post: synapse strengthens

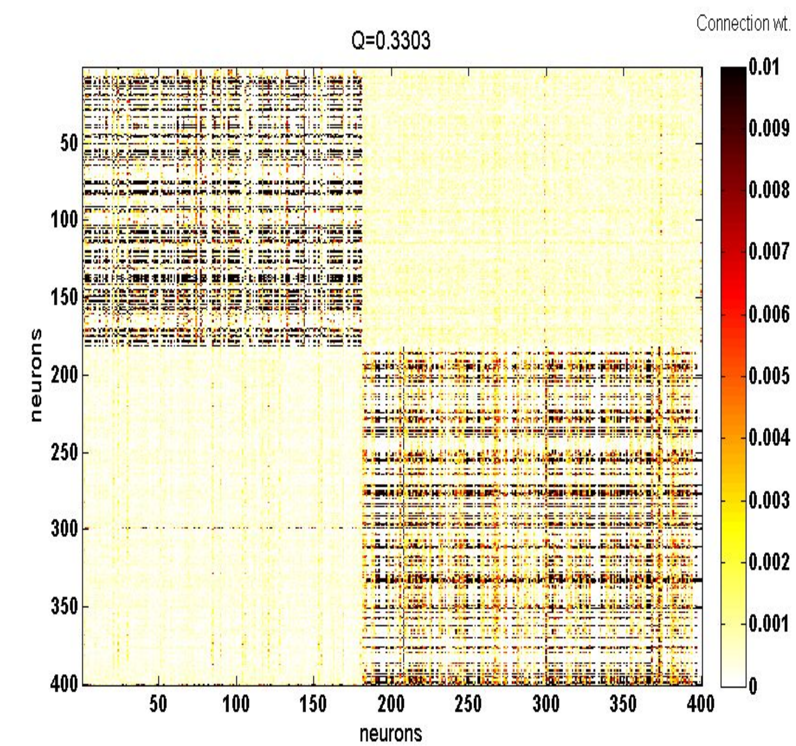


Modular networks emerge starting from homogeneous network

Initial



Final



Cooperation in Small Worlds: Society, State, and the Structure of Social Networks

Pepi Pandiloski, UChicago

July 2020

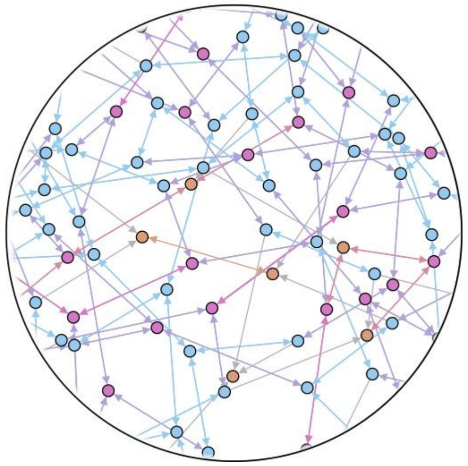
Prisoner's Dilemma on a Small-World Graph

- An ongoing puzzle in the development economics literature concerns generalized vs. localized norms of cooperation (Tabellini 2008; Alesina and Guiliano 2013; Greif and Tabellini 2017).
- My developing work aims to explain this by modelling a PD link-deletion game (Jackson et al. 2012; Bloch et. al. 2008) with n agents on a Watts-Stogatz graph $g(k, p)$.
- In my setup p serves as a proxy for the scope of cooperation, and there are increasing benefits of long distance cooperation (higher efficiency) measured by distance between nodes on the WS ring lattice.
- Two different strategies are analyzed:
  1. Some cooperative links are contractually non-defectable (State-enforced)
  2. Defector nodes are punished by neighbors of victims by cutting ties if they exist (Society-enforced)

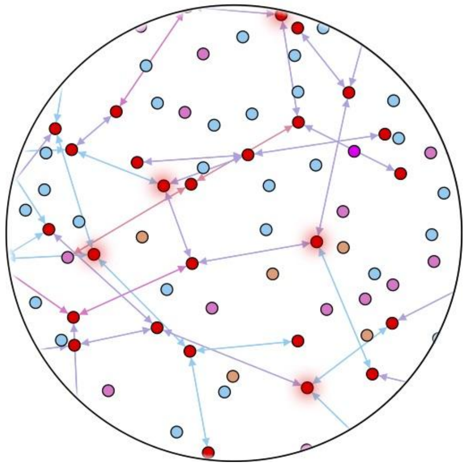
Initial results and further directions

- In my simulations, I start with an initial random $g_0(p, k)$, and then random nodes are drawn to decide whether to defect on a cooperative link given the game strategies. This is repeated until no nodes defect anymore, resulting in $g_\infty(p, k)$.
- Results suggest that in the state-enforced PD game higher p yields higher social welfare in $g_\infty(p, k)$ and efficiency is captured.
- In the socially-enforced PD game however, higher p weakens the ability of communal enforcement to deter defections and cooperative networks collapse ($g_\infty(p, k)$ is empty, zero welfare).
- This implies a stability-efficiency tension that is common in many games on networks, introducing a new perspective to a standing puzzle in the development economics literature.
- Currently working with Facebook's global Social Connectedness Index to empirically test implications of my model.

Distributed consent and its impact on privacy and observability in social networks



Juniper Lovato (University of Vermont)
Antoine Allard (Université Laval)
Randall Harp (University of Vermont)
Laurent Hébert-Dufresne (University of Vermont)



pre-print available at arxiv.org/abs/2006.16140

Distributed Consent

If data is distributed across individuals, so should consent.

Distributed consent: Consent conditional on that of neighbors.

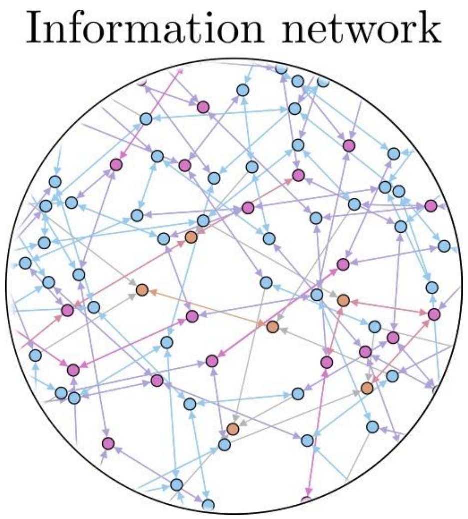
Imagine a platform with the following privacy levels:

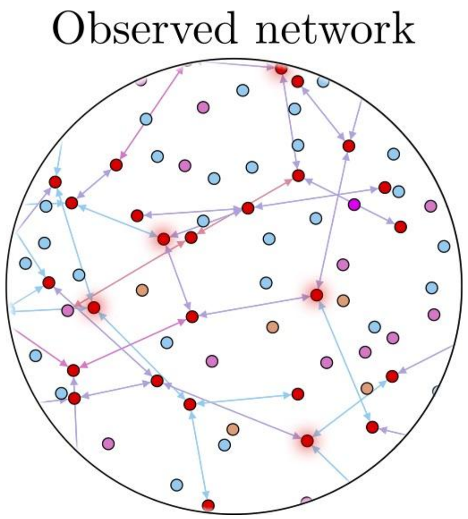
- **Level 0.** You openly share data and are vulnerable to surveillance.
- **Level 1.** You only share data with network neighbors.
- **Level 2.** You only share with network neighbors whose privacy level is set at least to 1.

Distributed consent and its impact on privacy and observability in social networks.
J. Lovato, A. Allard, R. Harp, L. Hébert-Dufresne. arXiv:2006.16140 (2020)

Results: protecting yourself from friends of friends

- **Low adoption** (1 in 5): a large unobservable and connected subnetwork emerges, privacy can co-exist with connectedness and information flow.
- **Large adoption:** (1 in 3): close to 50% of accounts are now protected, and their privacy settings only prevent about 22% of data flow.





Contact: jlovato@uvm.edu
Distributed consent and its impact on privacy and observability in social networks.
J. Lovato, A. Allard, R. Harp, L. Hébert-Dufresne. arXiv:2006.16140 (2020)

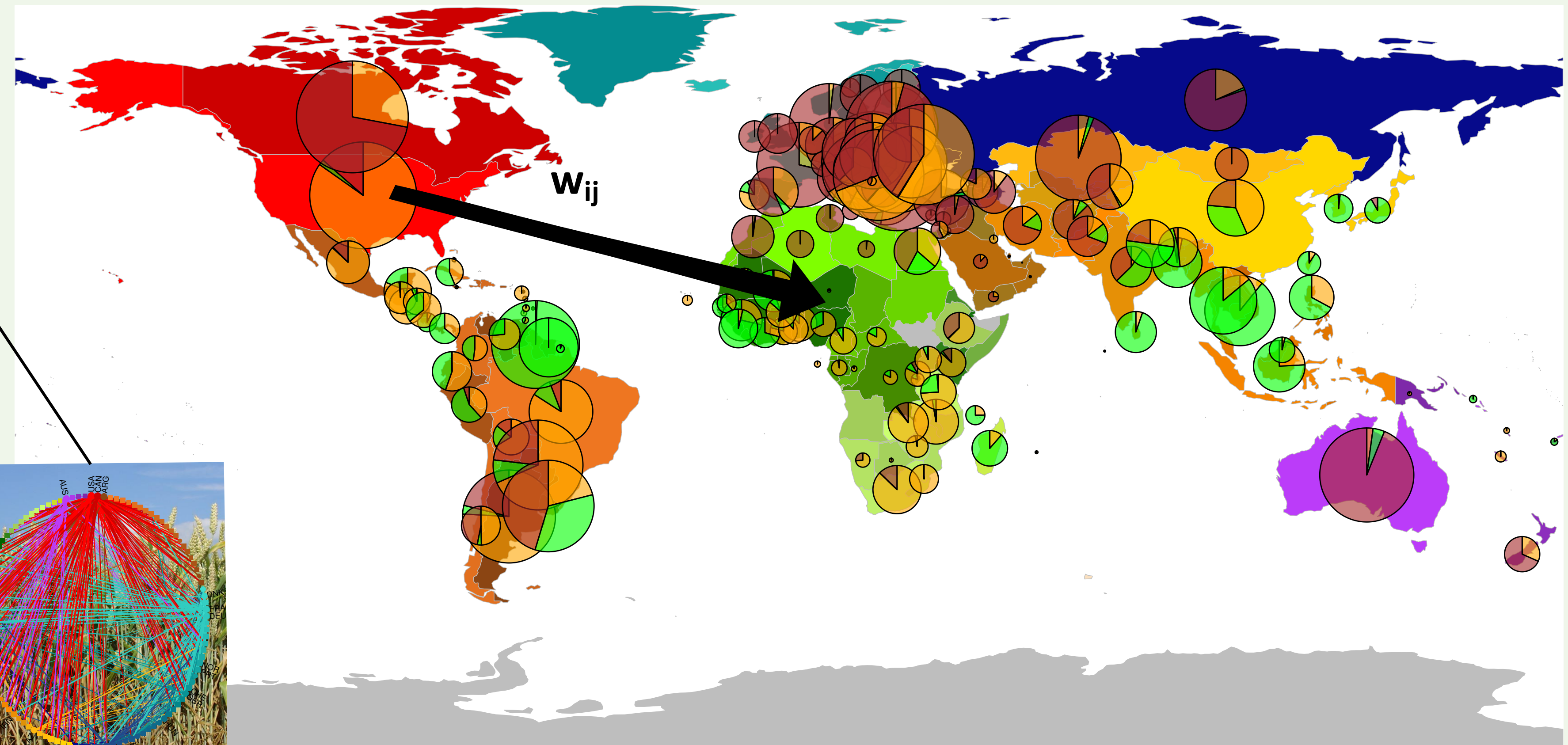
International crop trade networks: the impact of shocks and cascades

Paper:
https://iopscience.iop.org/article/10.1088/1748-9326/ab4864/meta
Environmental Research Letters (2019)

Rebekka Burkholz (Harvard University)
Frank Schweitzer (ETH Zurich)

Observed:
international crop trade networks

Production per head (kcal) of maize, rice, wheat 2013



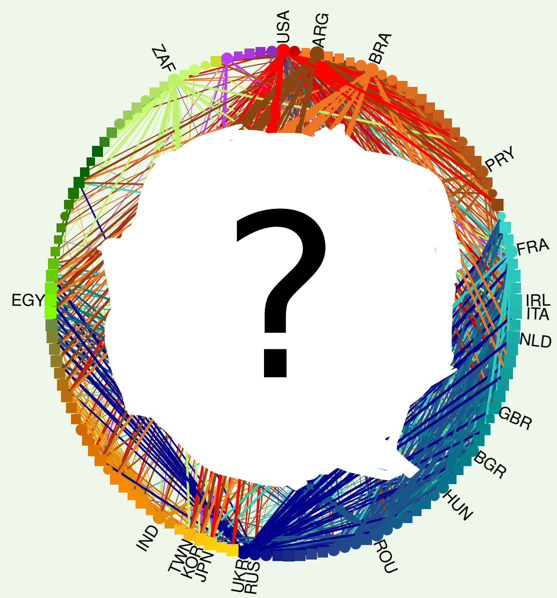
What if something goes wrong?

Shock: harvest loss or increasing demand in one country

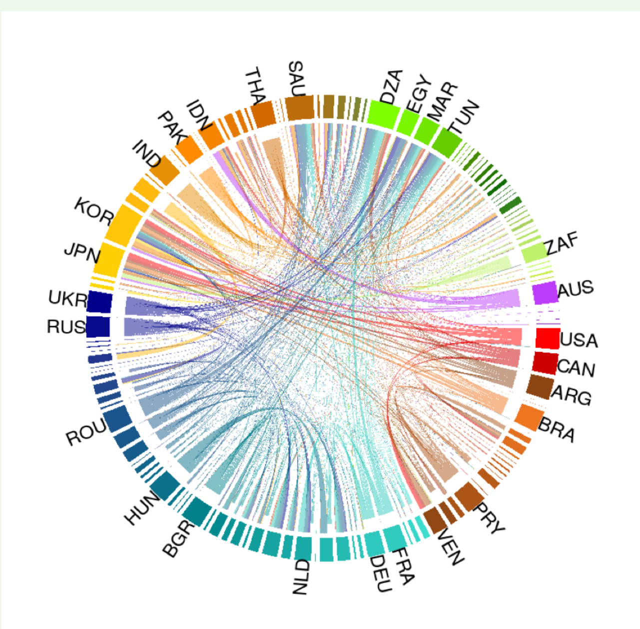
Model the shock response of the system

Network formation model is too hard:

- subsidies
- trade agreements
- taxes
- harvest times
- speculation
- product quality
- etc.



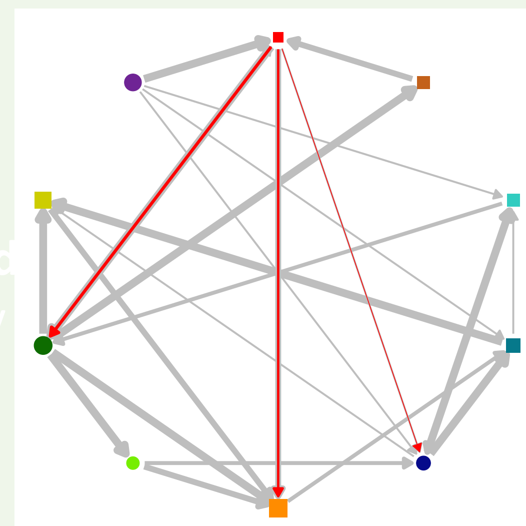
Result:



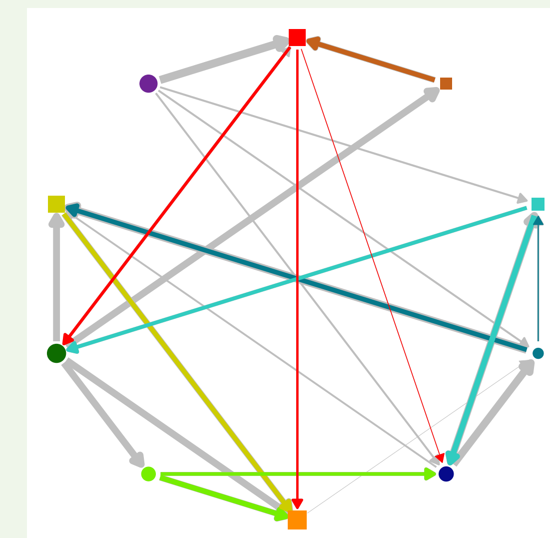
A network of higher order import dependence

Idea:
Model only **change** of **network structure** as **cascade** process:
Compensation of shock by export restriction

t = 1



t = T



A shocked country reduces its exports:

$$ex\_i(t+1) = \max(ex_i(t) - deficit_i, 0)$$

$$w_{ij}(t) = ex_i(t)\frac{w_{ij(0)}}{ex_i(0)}$$