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Fake News in Social Nets

how to observe, study, and contrast them

Torino, March 31, 2020

http://www.di.unito.it/~ruffo/talks/2020_Mar_LABICT.pdf



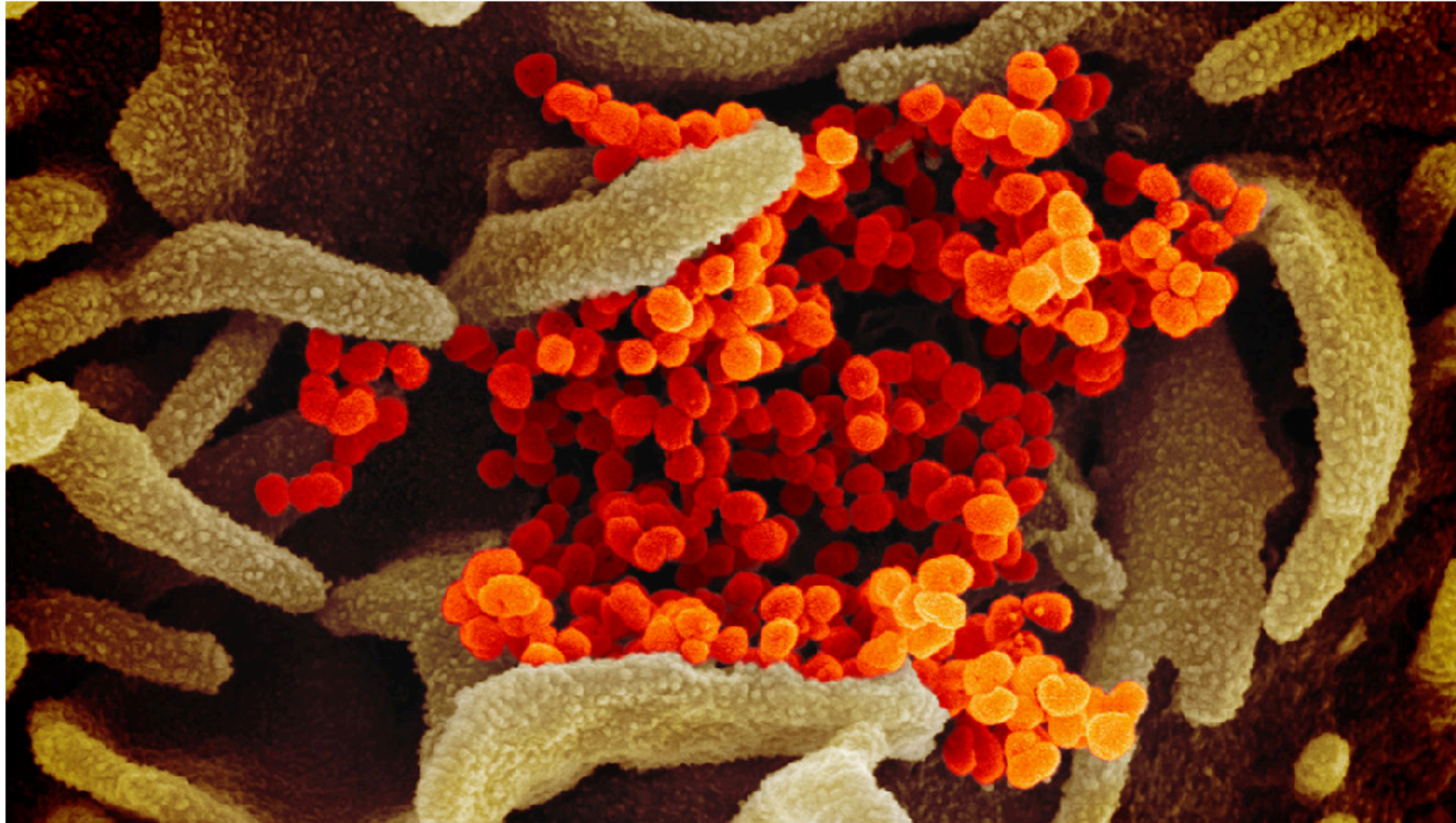
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Posts on social media and even a scientific paper have suggested the coronavirus that causes COVID-19—seen here in orange, emerging from a cell—originated in a virology lab in Wuhan, China. NATIONAL INSTITUTE OF ALLERGY AND INFECTIOUS DISEASES

Scientists 'strongly condemn' rumors and conspiracy theories about origin of coronavirus outbreak

By [Jon Cohen](#) | Feb. 19, 2020 , 7:00 AM

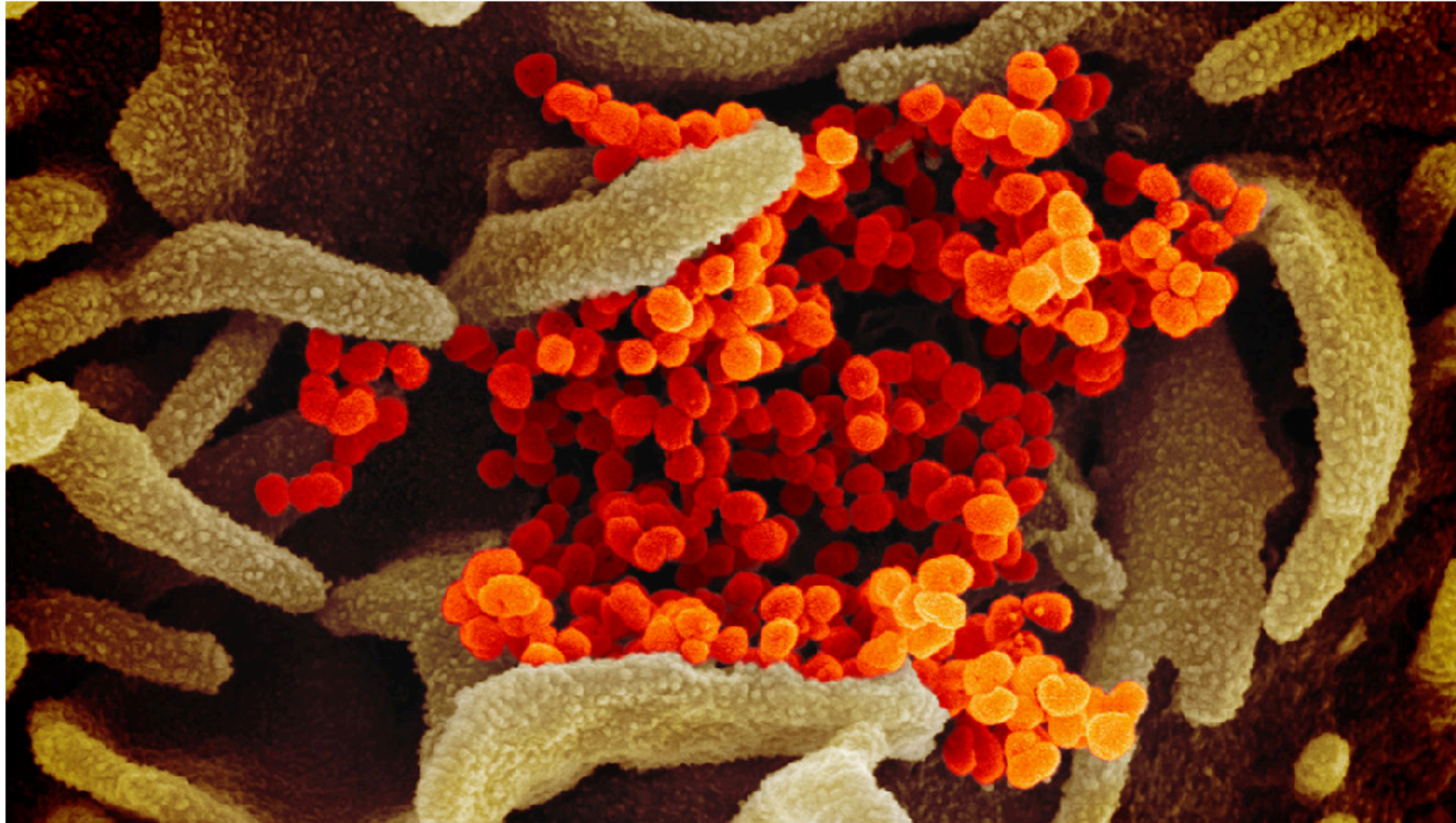
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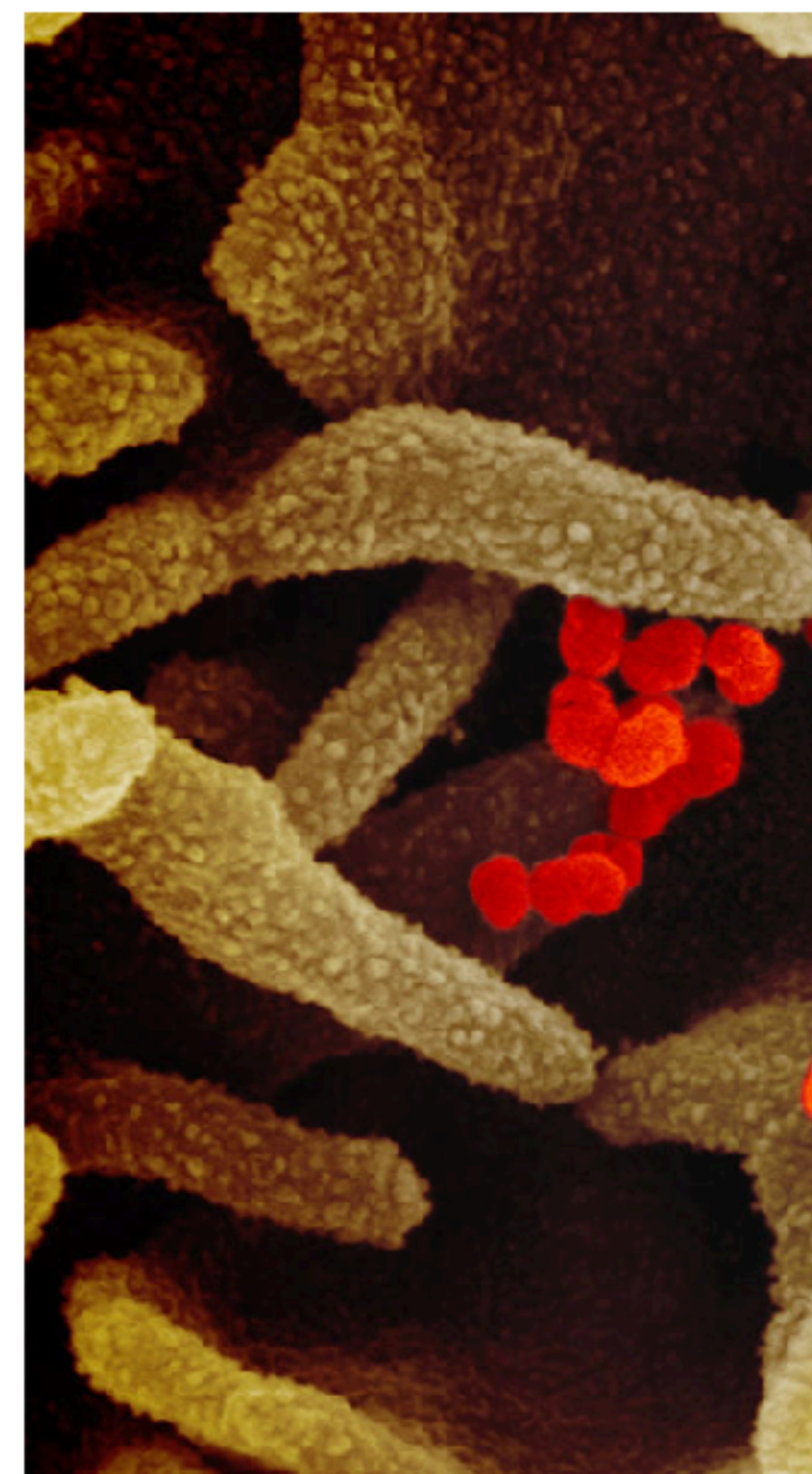
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Wuhan e il complotto – Ecco perché gli scienziati non credono il virus sia uscito da un laboratorio



di Laura Margottini | 2 MARZO 2020



Come se non fosse già sufficiente la questione del "salto di specie" di virus da animale a uomo, (come è accaduto con il **Coronoavirus-19**, che dal pipistrello, si sospetta abbia colonizzato un altro animale e da lì l'uomo), potenziali rischi di pandemie da agenti patogeni sconosciuti vengono anche da un settore della ricerca scientifica, chiamata Gain-of Function (GoF). Si

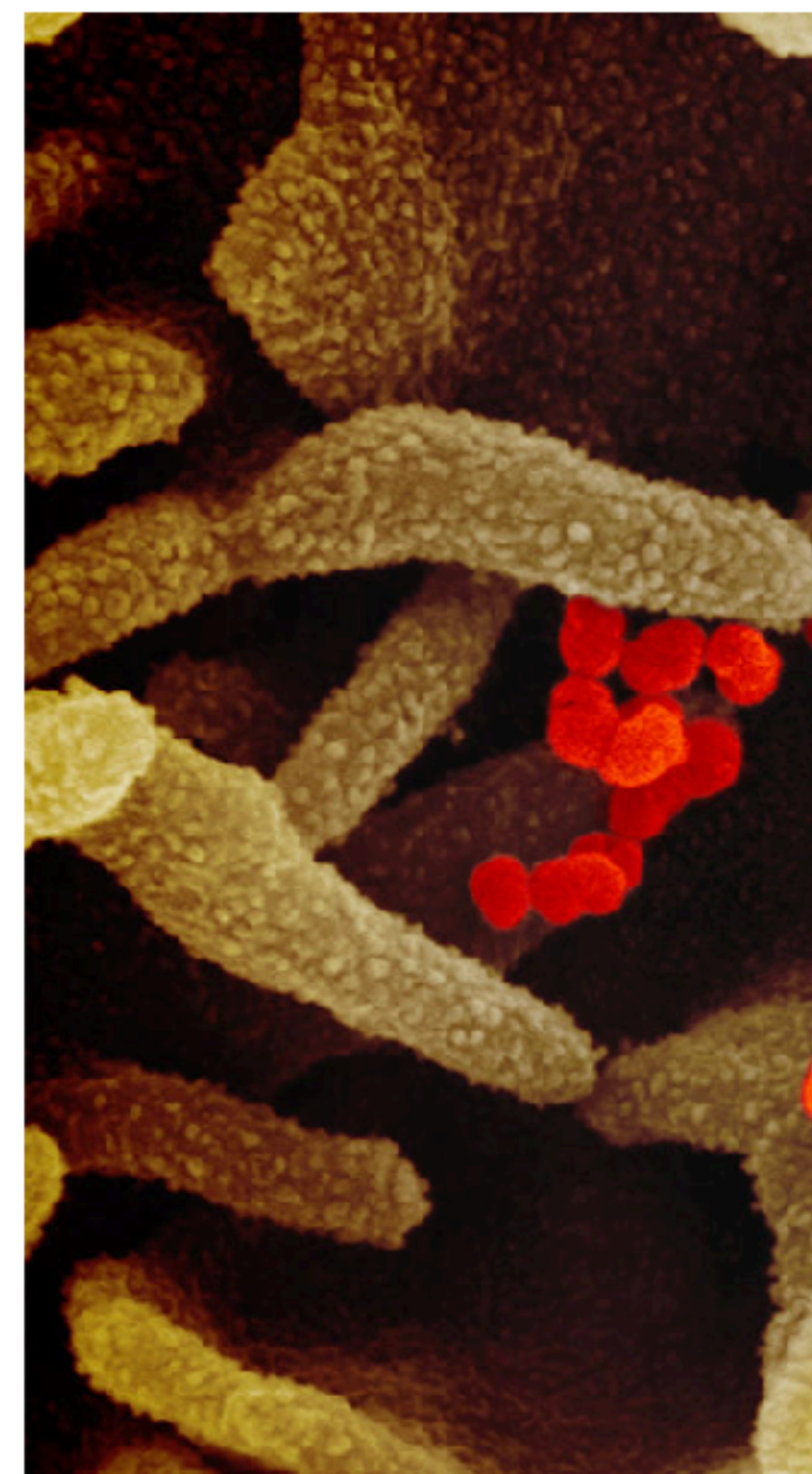
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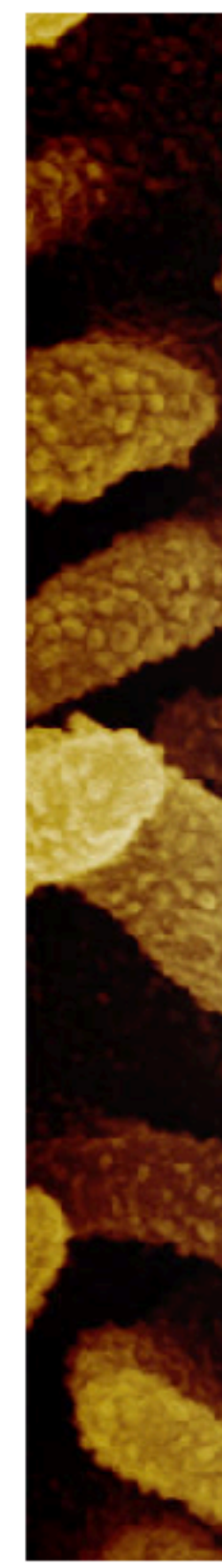
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Coronavirus, Sharon Stone: "A Venezia cigni e delfini, una settimana al mese di smartworking sempre"



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La star americana, che da giorni segue lo sviluppo della pandemia con particolare affetto nei confronti del nostro paese, fa una provocazione

Scie theo

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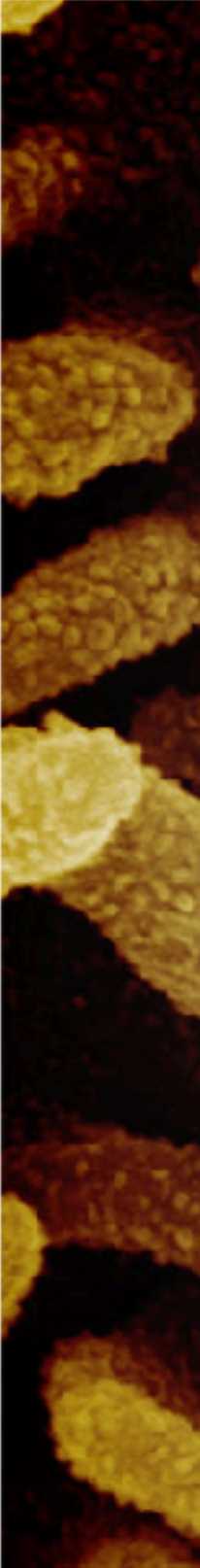
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What I do (and don't....)

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- ❖ Academic and industrial research

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 - ❖ I don't look for simple explanations to complex problems (e.g., gullible people is also stupid!)

Agenda

- ❖ Segregation and polarization
- ❖ The Strange case of Lajello
- ❖ Modeling **disinformation diffusion**
 - ❖ the role of **forgetting** and **news verification**
 - ❖ the role of **segregation**
 - ❖ evaluating **debunking strategies**
- ❖ Discussion and **conclusions**



Segregation and Polarization

Segregation

Segregation

- ❖ Society's structure is shaped in function of **immutable characteristics** of individuals
 - ❖ ethnic group
 - ❖ age
 - ❖ religious belief
 - ❖ ...

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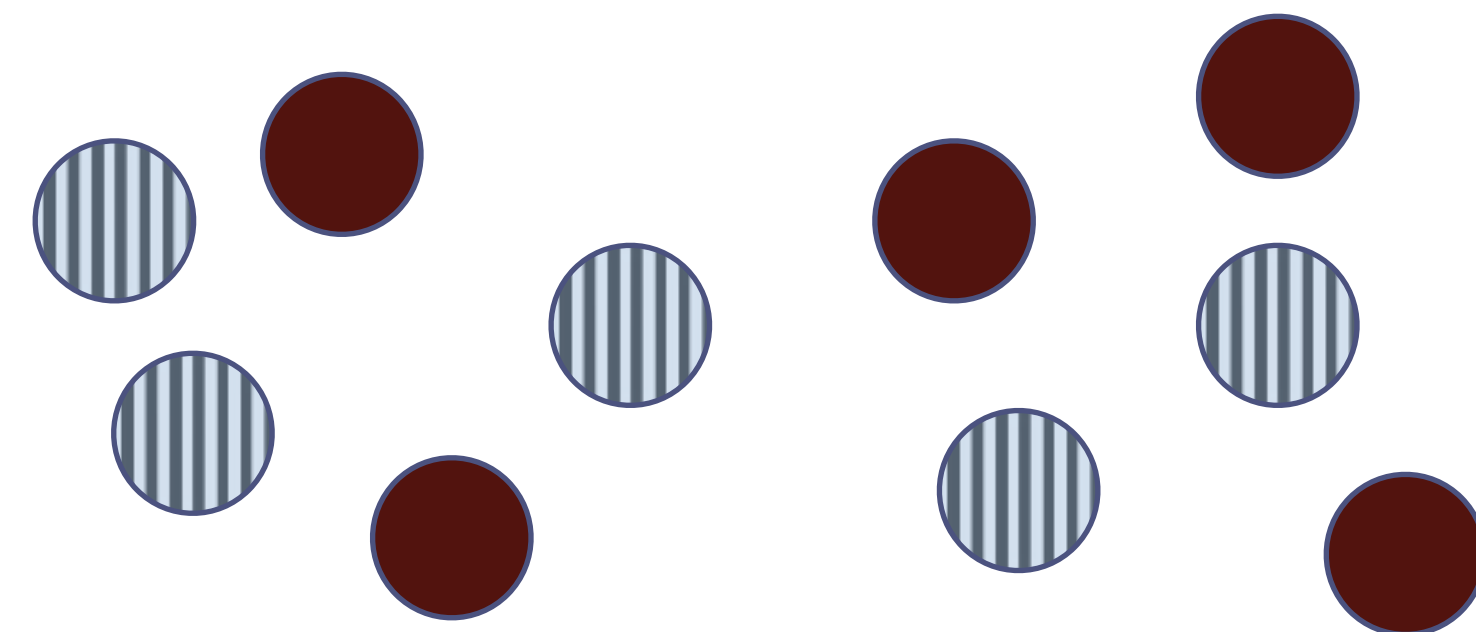
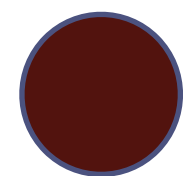
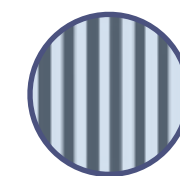
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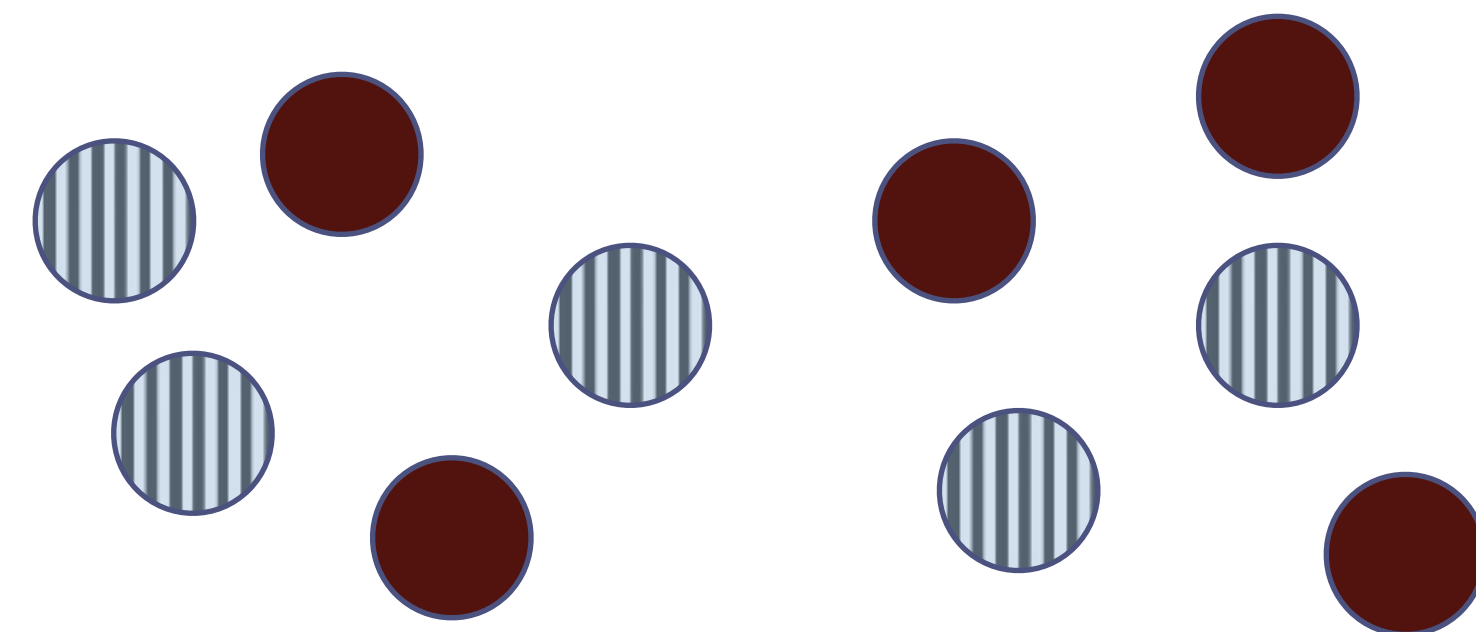
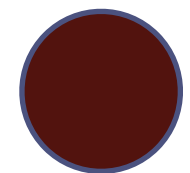
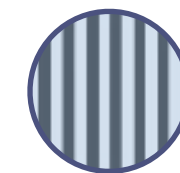
❖ religious belief

❖ ...



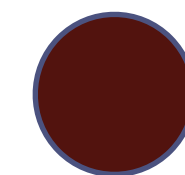
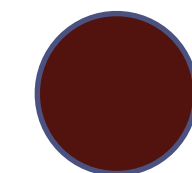
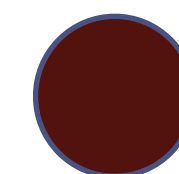
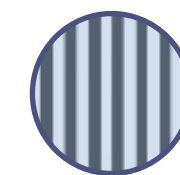
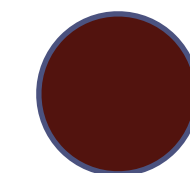
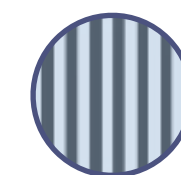
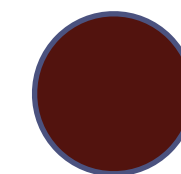
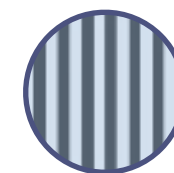
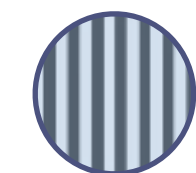
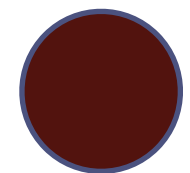
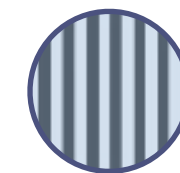
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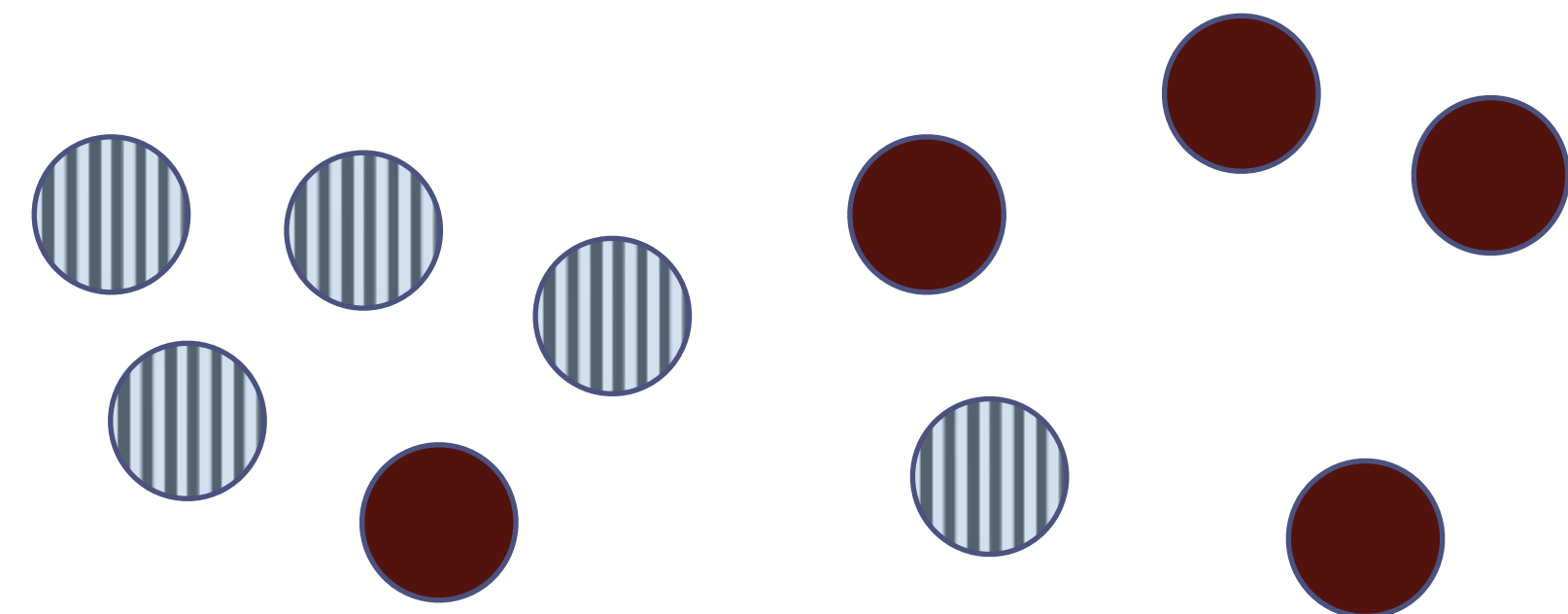
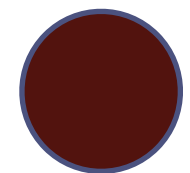
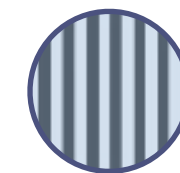
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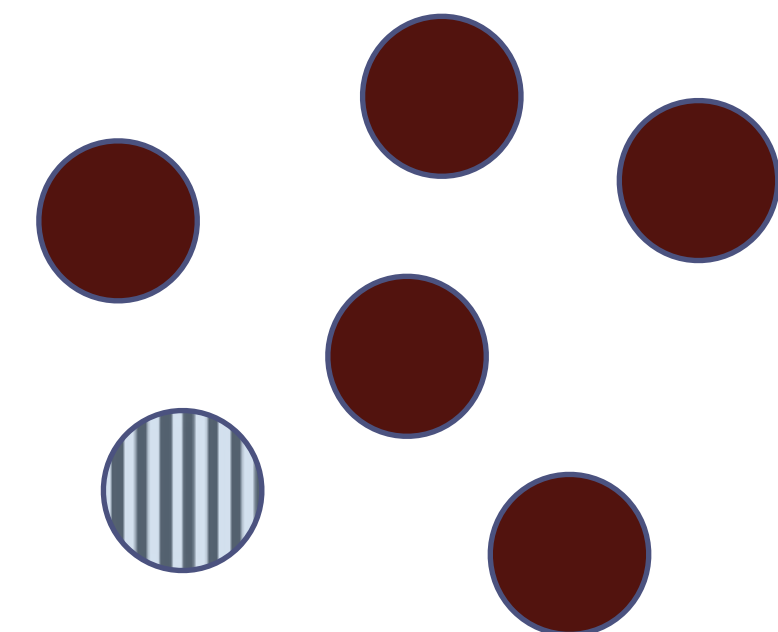
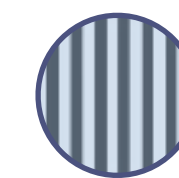
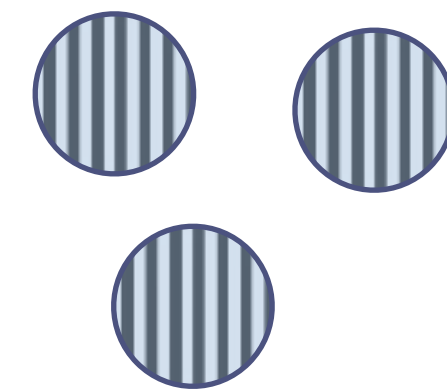
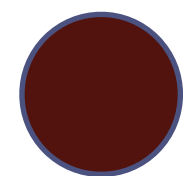
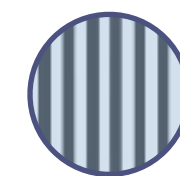
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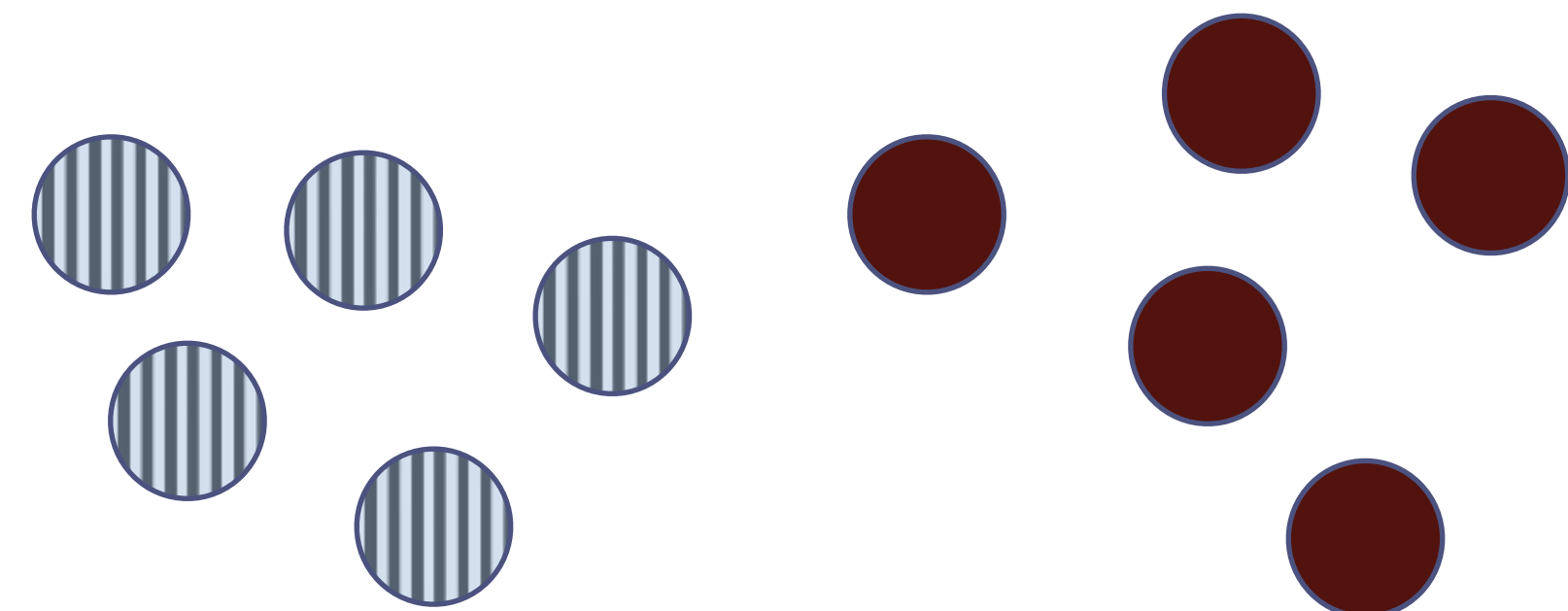
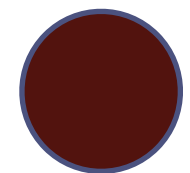
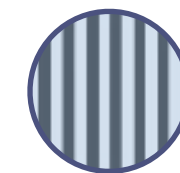
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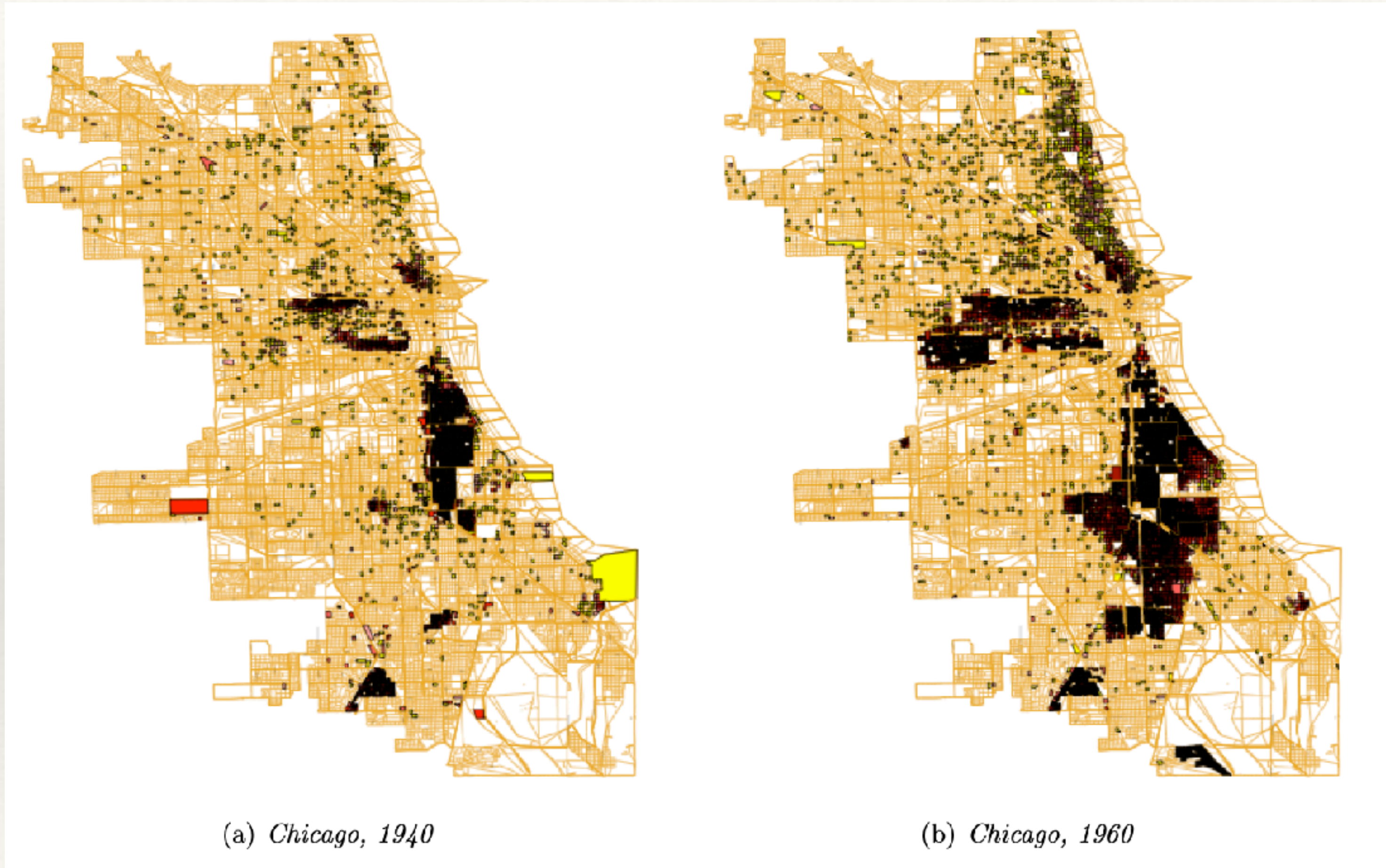
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Natural spatial "signature" in cities

- ❖ Formation of homogeneous (according to some "type" or "class") neighbors in cities
- ❖ Which are the causes of "ghettization"?



The Schelling model


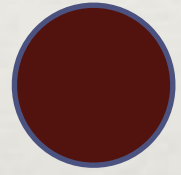
The Schelling model

- ❖ Can spatial segregation arise from the effect of homophily operating at a local level?


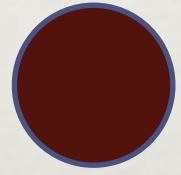
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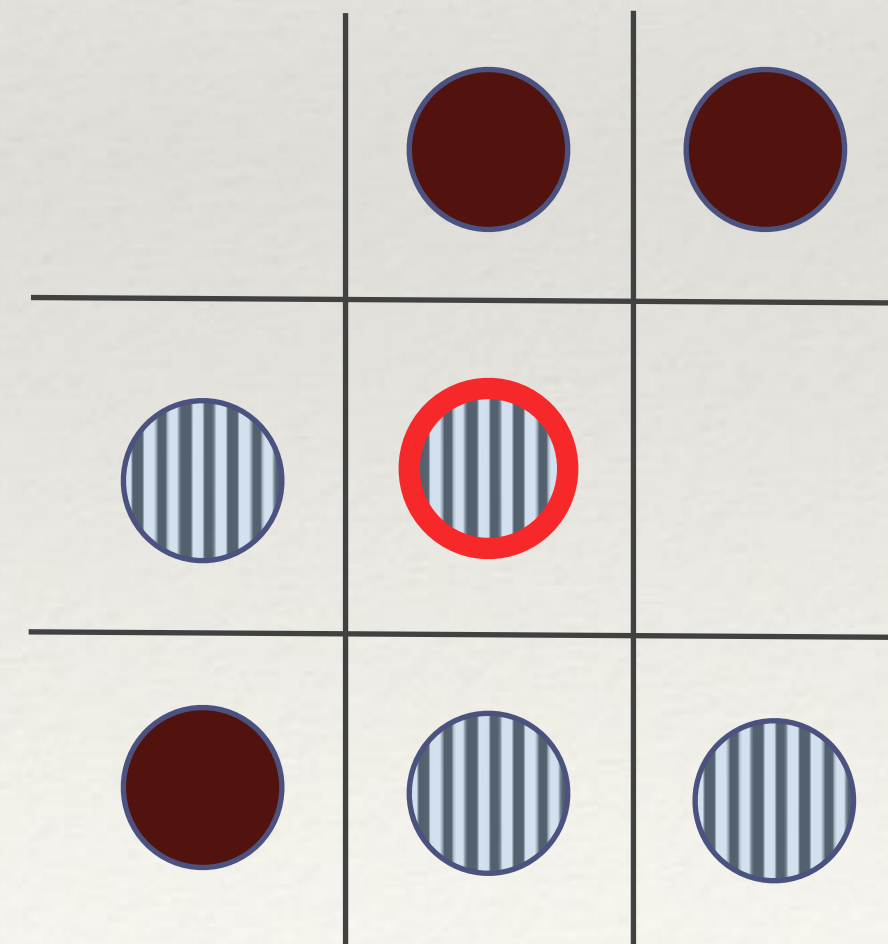
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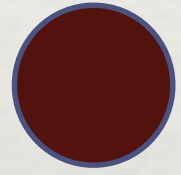
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- ❖ Agents:
 - ❖ two types:  
 - ❖ immutable characteristics

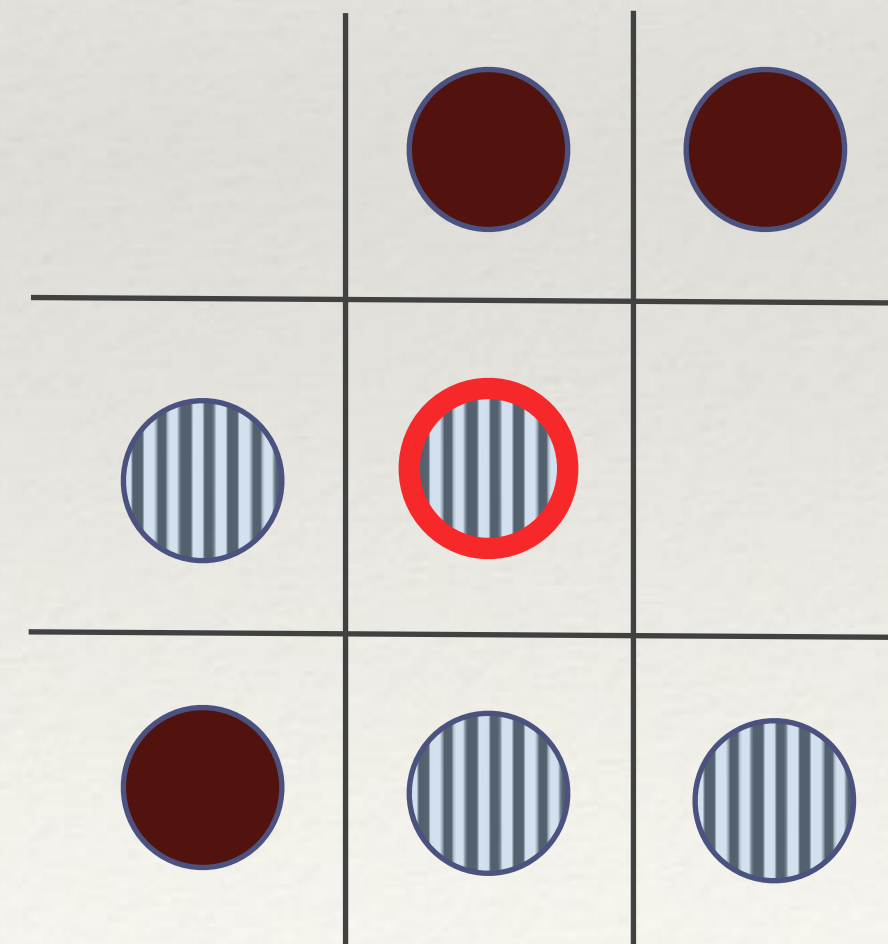
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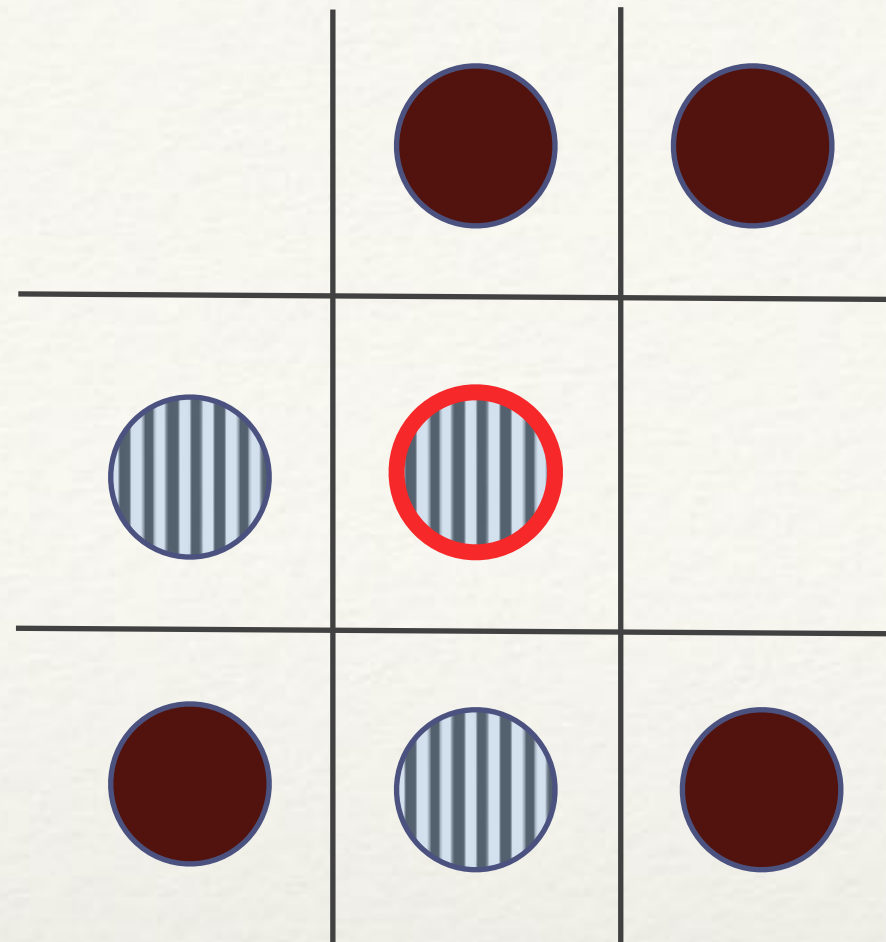
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 - ❖ immutable characteristics
- ❖ Agents reside in a cell of a grid
 - ❖ some cells contain agents
 - ❖ some other cells are unpopulated



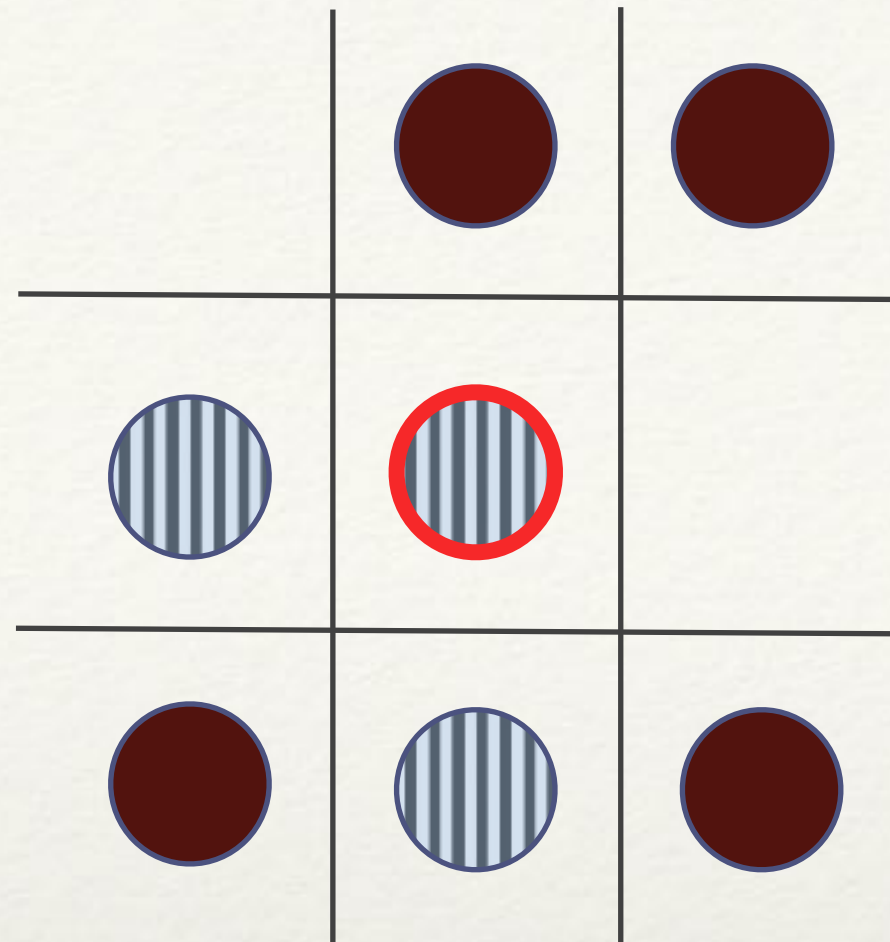
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 - ❖ some cells contain agents
 - ❖ some other cells are unpopulated
- ❖ Neighbors: 8 other cells "touching" an agent



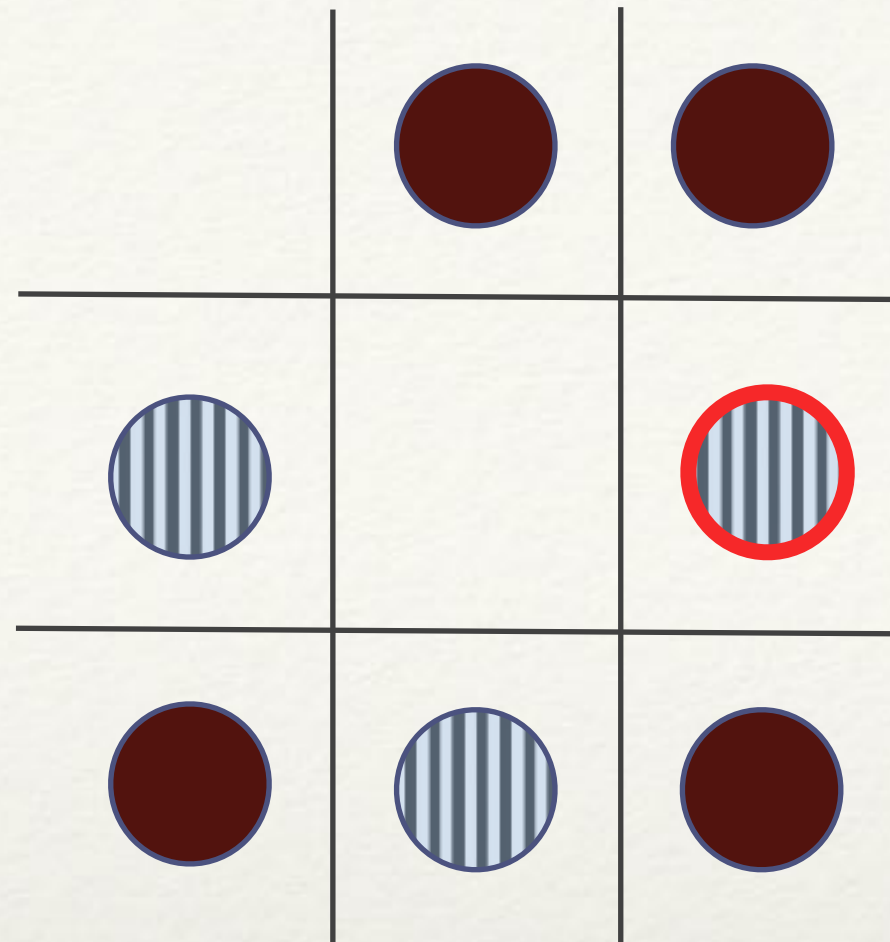


- ❖ Each agent wants to have at least t neighbors of their own type
- ❖ If an agent find $< t$ neighbors of the same type, then they are **unsatisfied**
- ❖ If unsatisfied, they want to **move**



$t = 3 \Rightarrow :-()$

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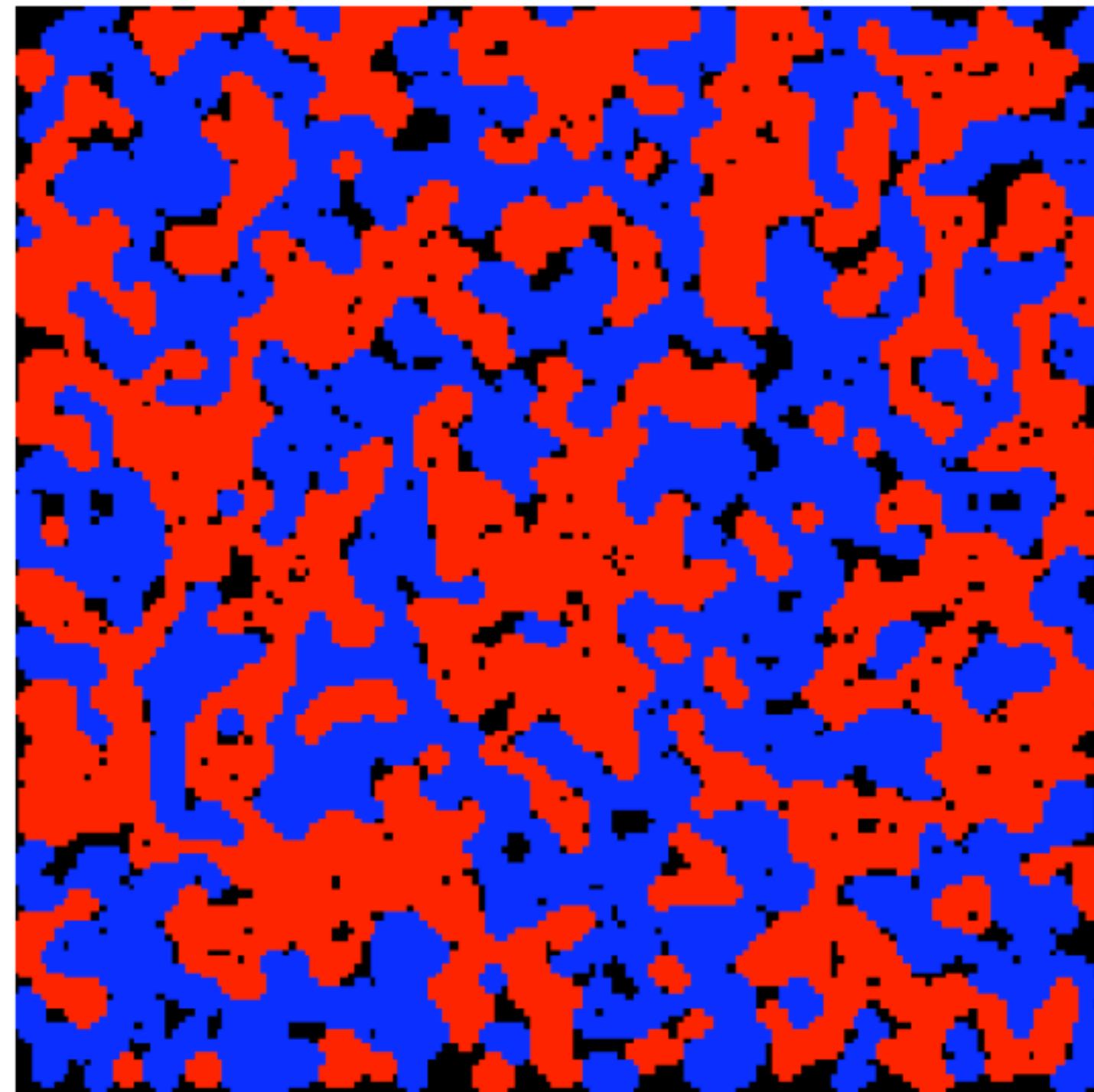


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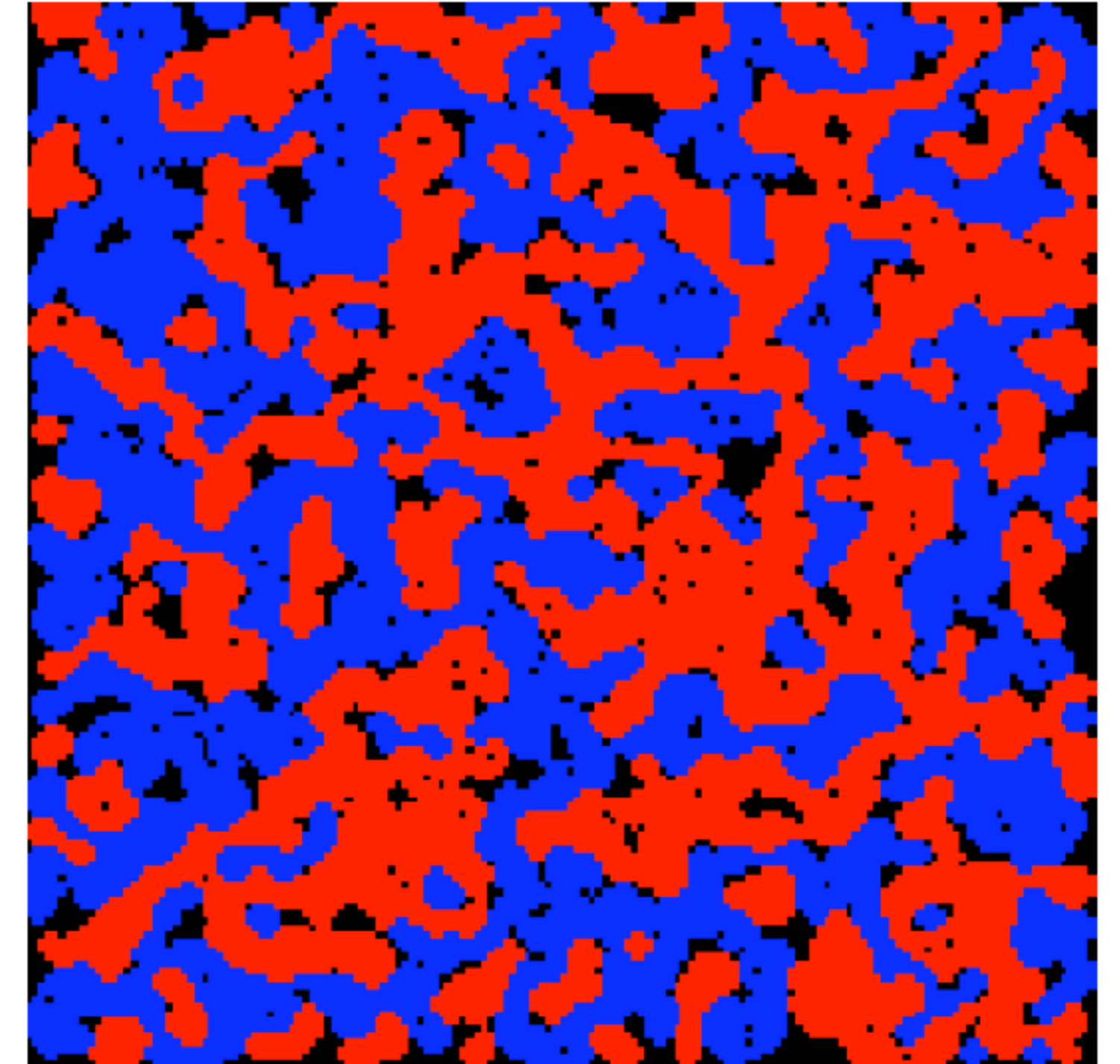
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Larger examples

- ❖ Computer simulations to look for patterns at larger scale
- ❖ We want to run different simulations and make some comparisons
=> integrated pattern?
- ❖ on the right: two runs of a simulations of the Schelling model with a threshold t of 3
 - ❖ 150x150 grid
 - ❖ 10,000 agents



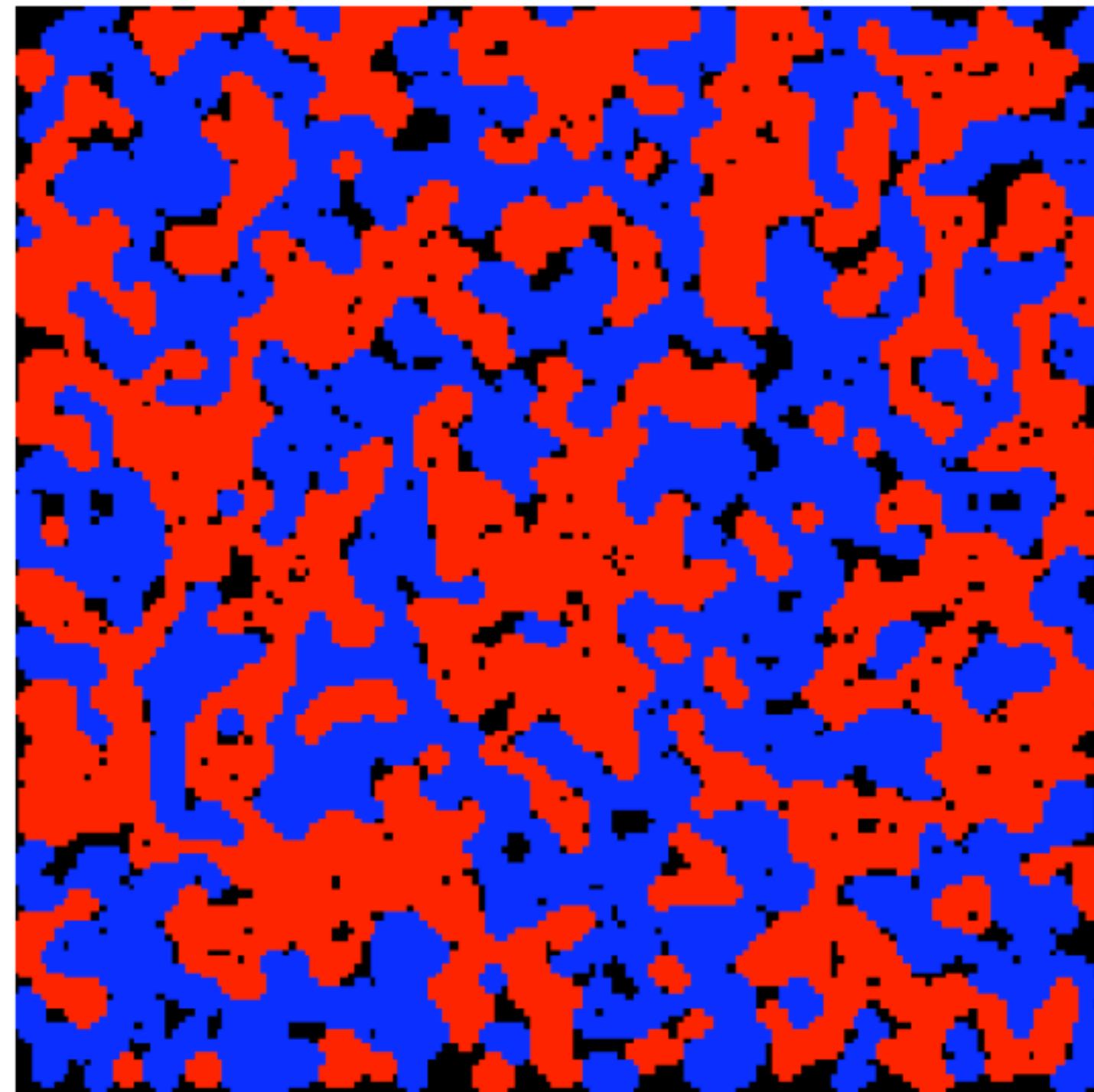
(a) *A simulation with threshold 3.*



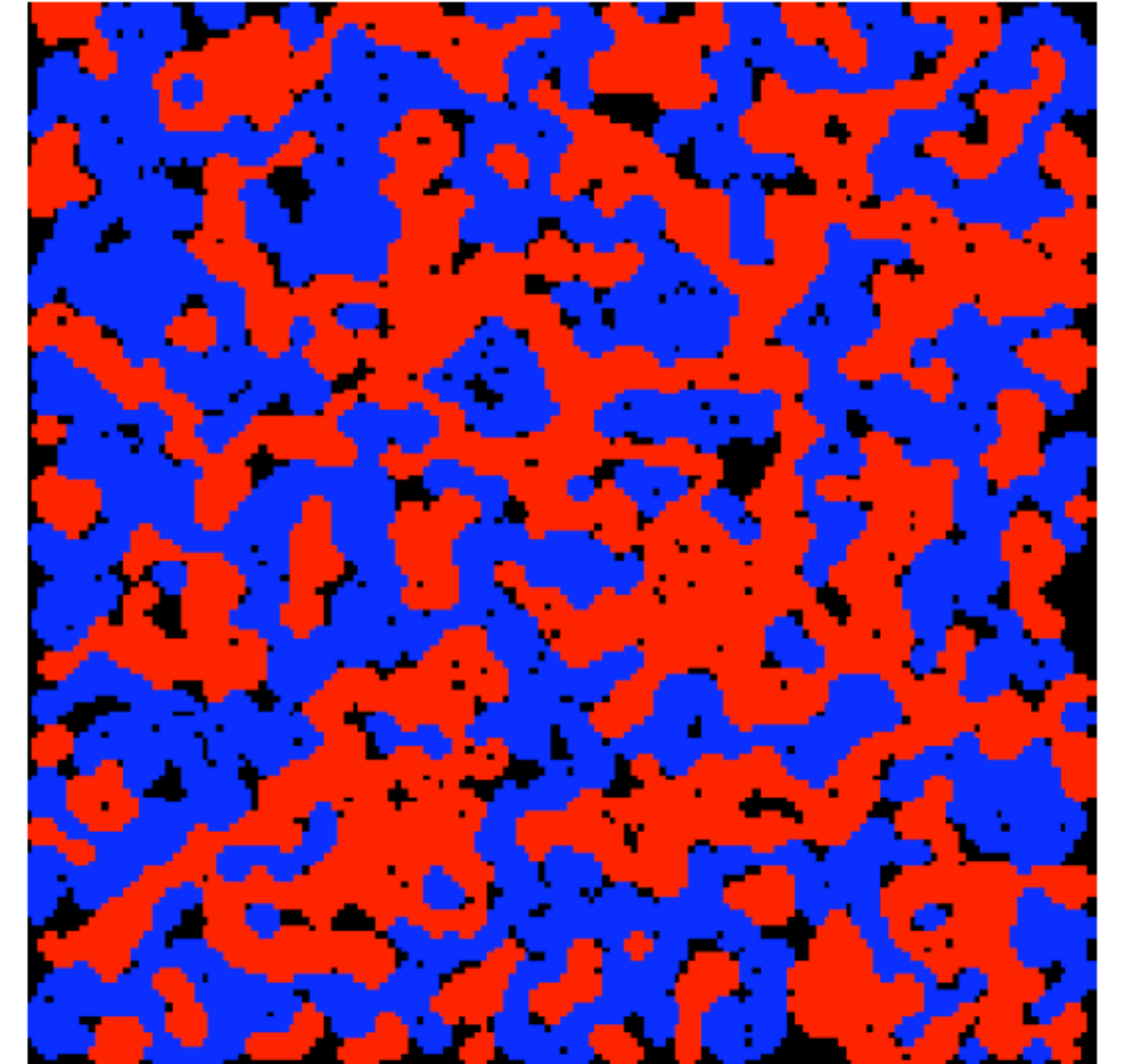
(b) *Another simulation with threshold 3.*

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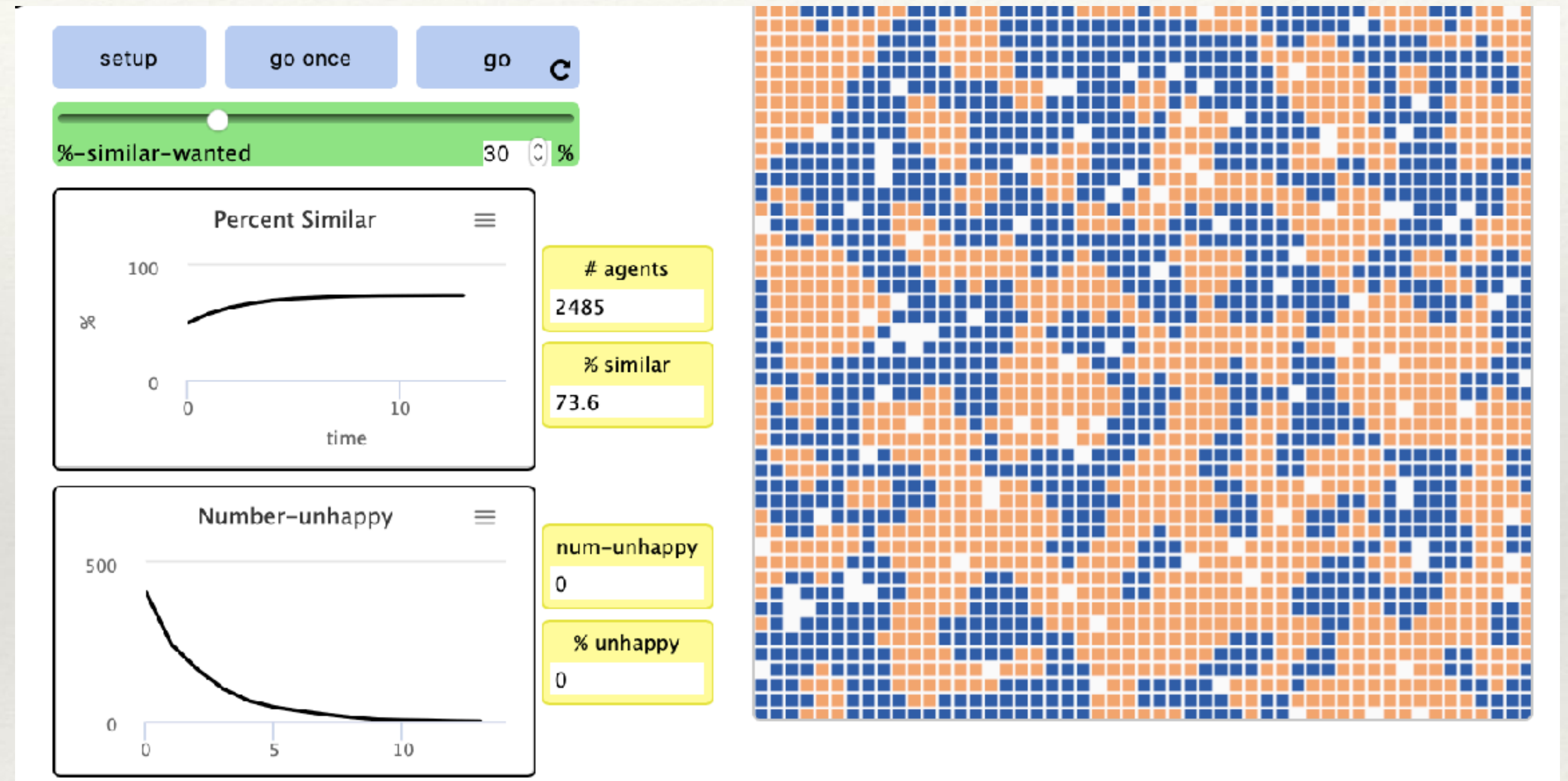


(b) *Another simulation with threshold 3.*

Segregation emerges even when agents accept to be a minority!

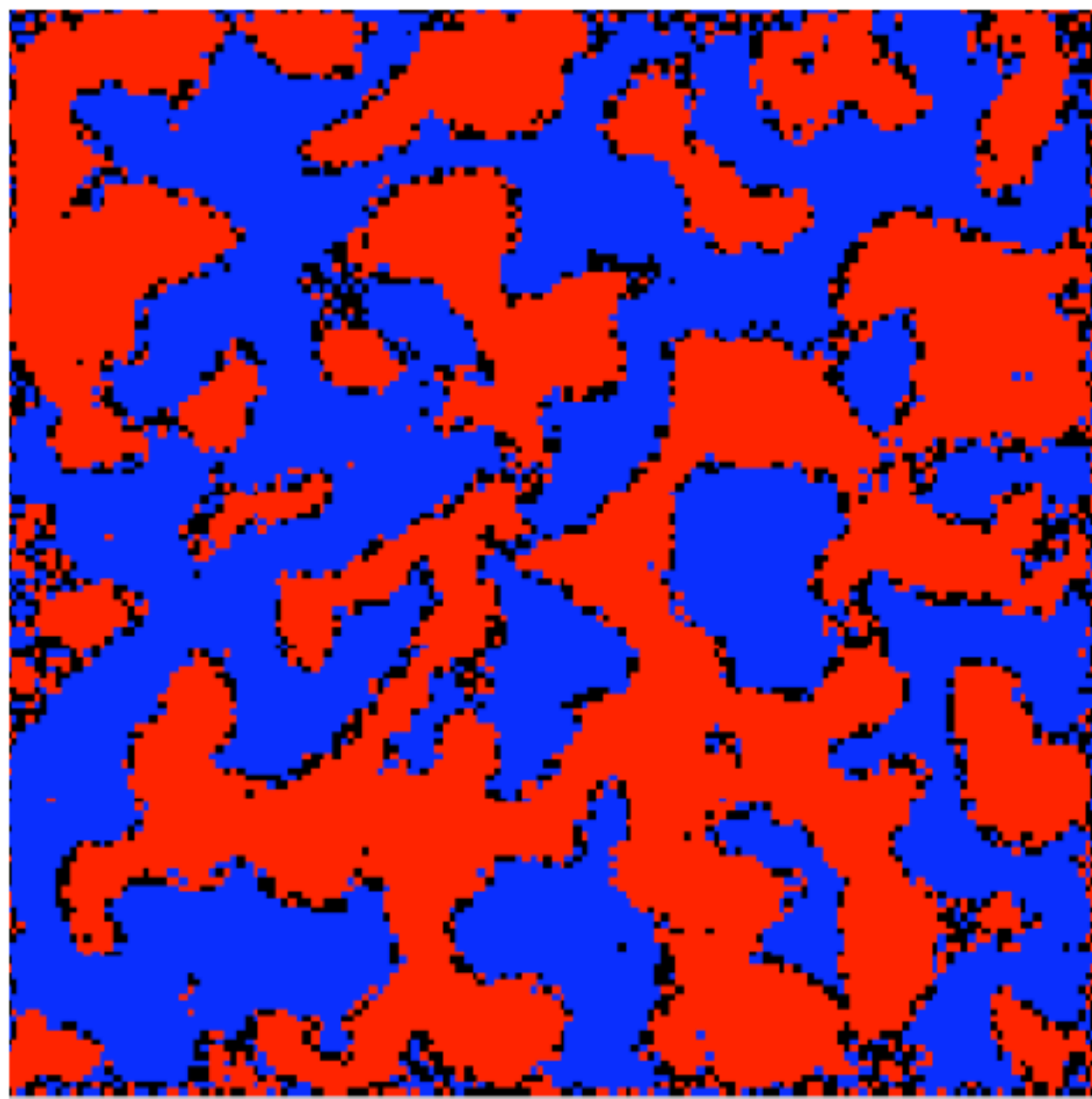
NetLogo

Agent based simulations

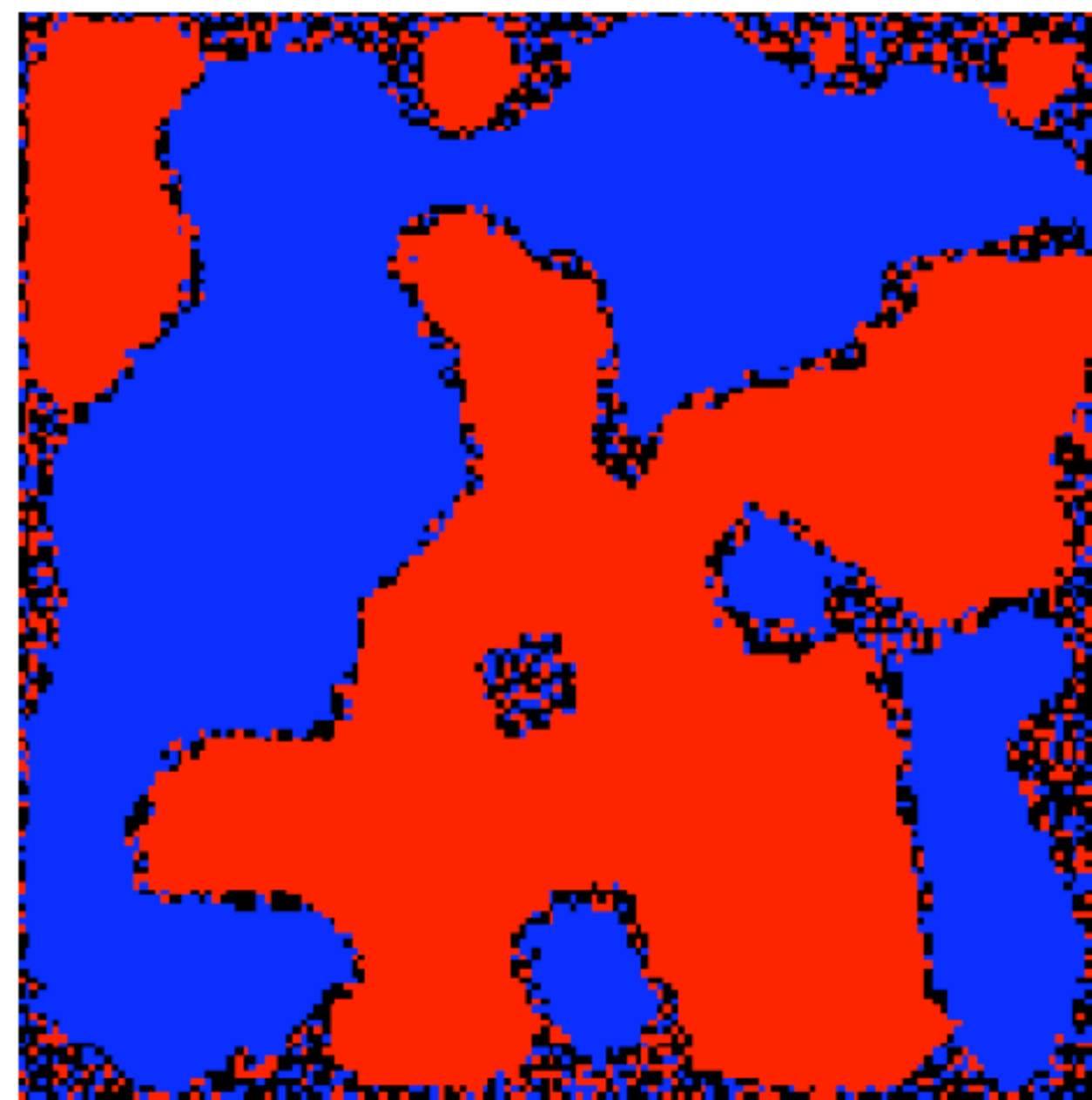


<http://www.netlogoweb.org/launch#http://www.netlogoweb.org/assets/modelslib/Sample%20Models/Social%20Science/Segregation.nlogo>

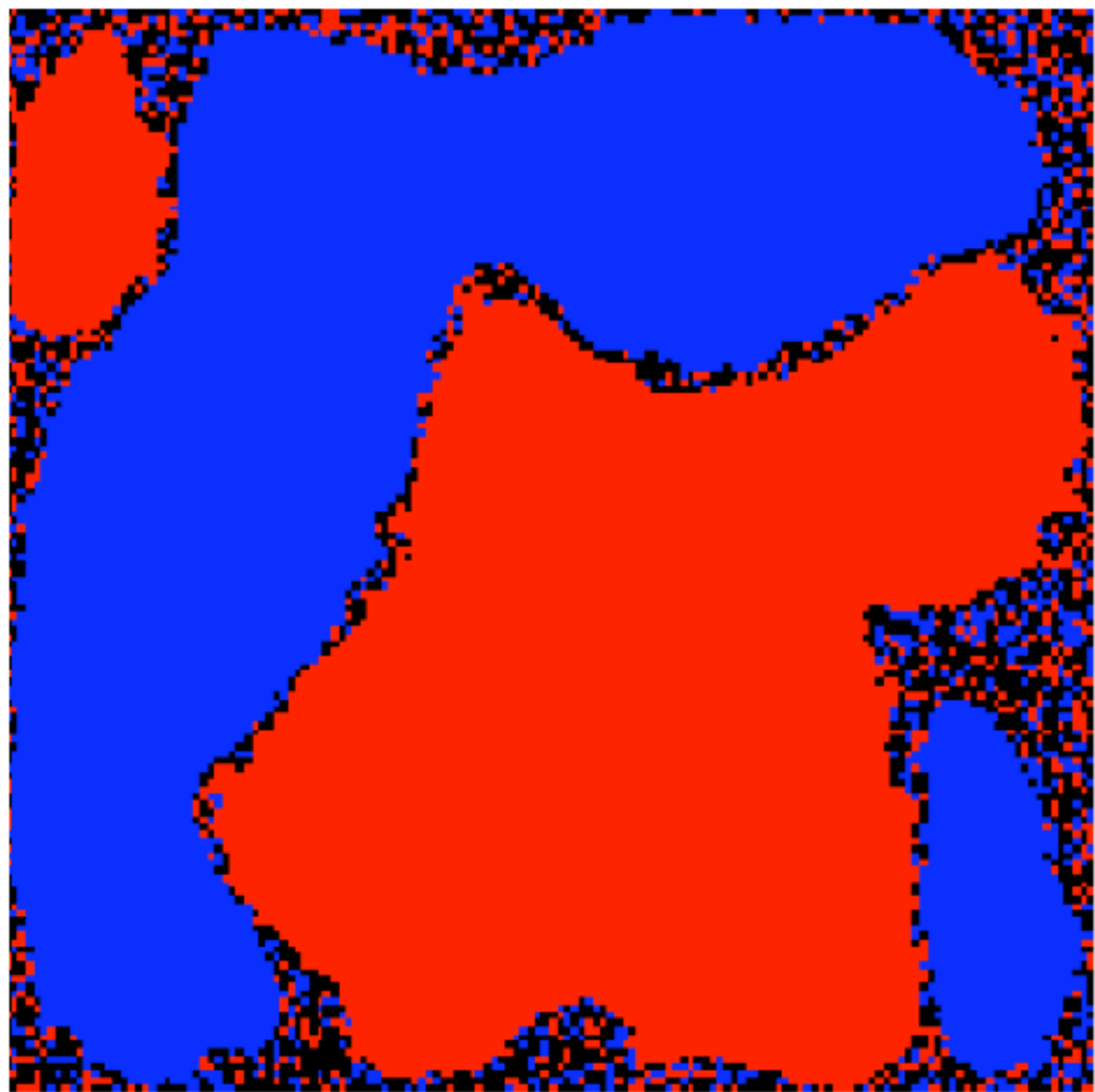
$t > 3 \Rightarrow$



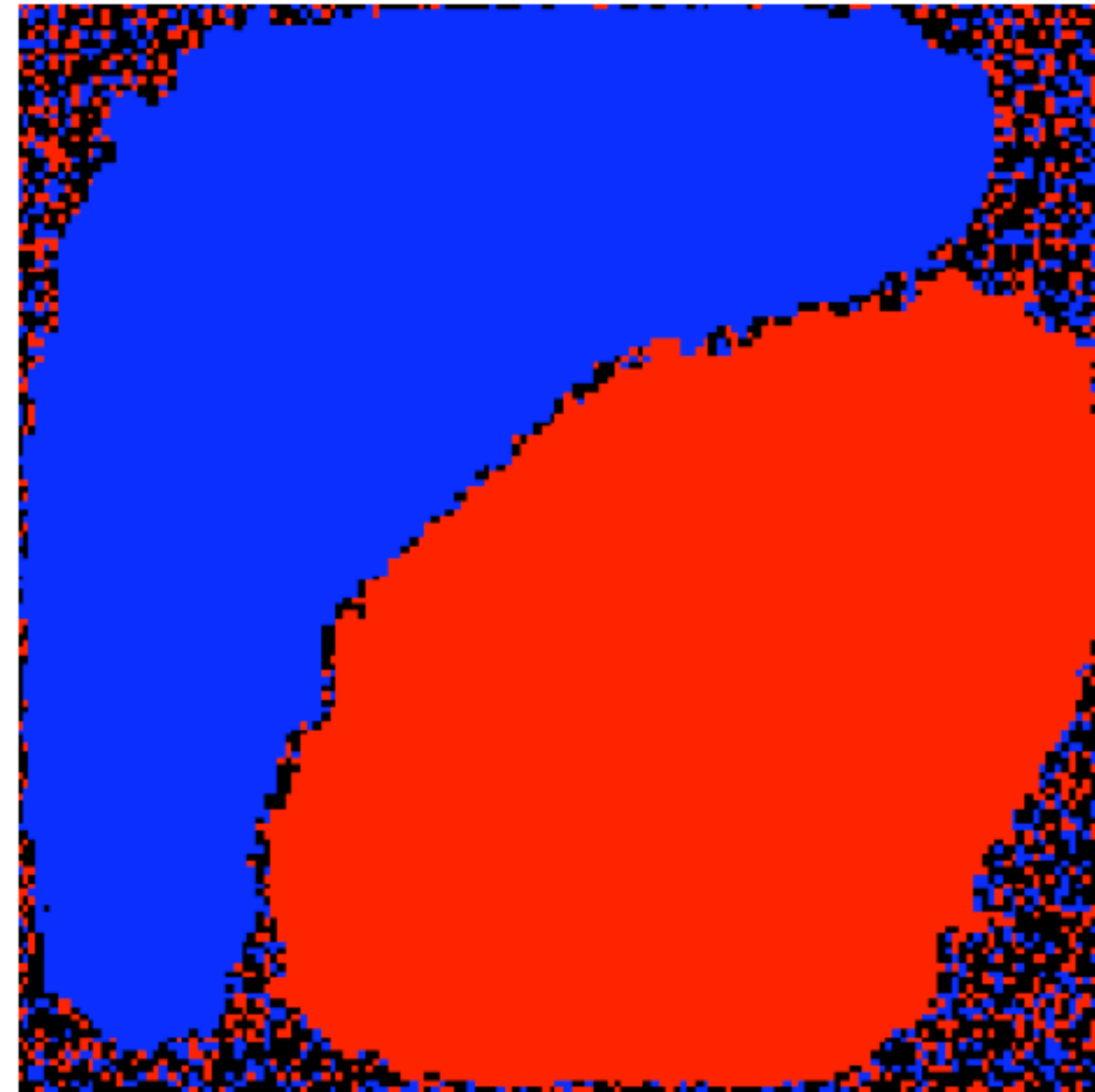
(a) After 20 steps



(b) After 150 steps

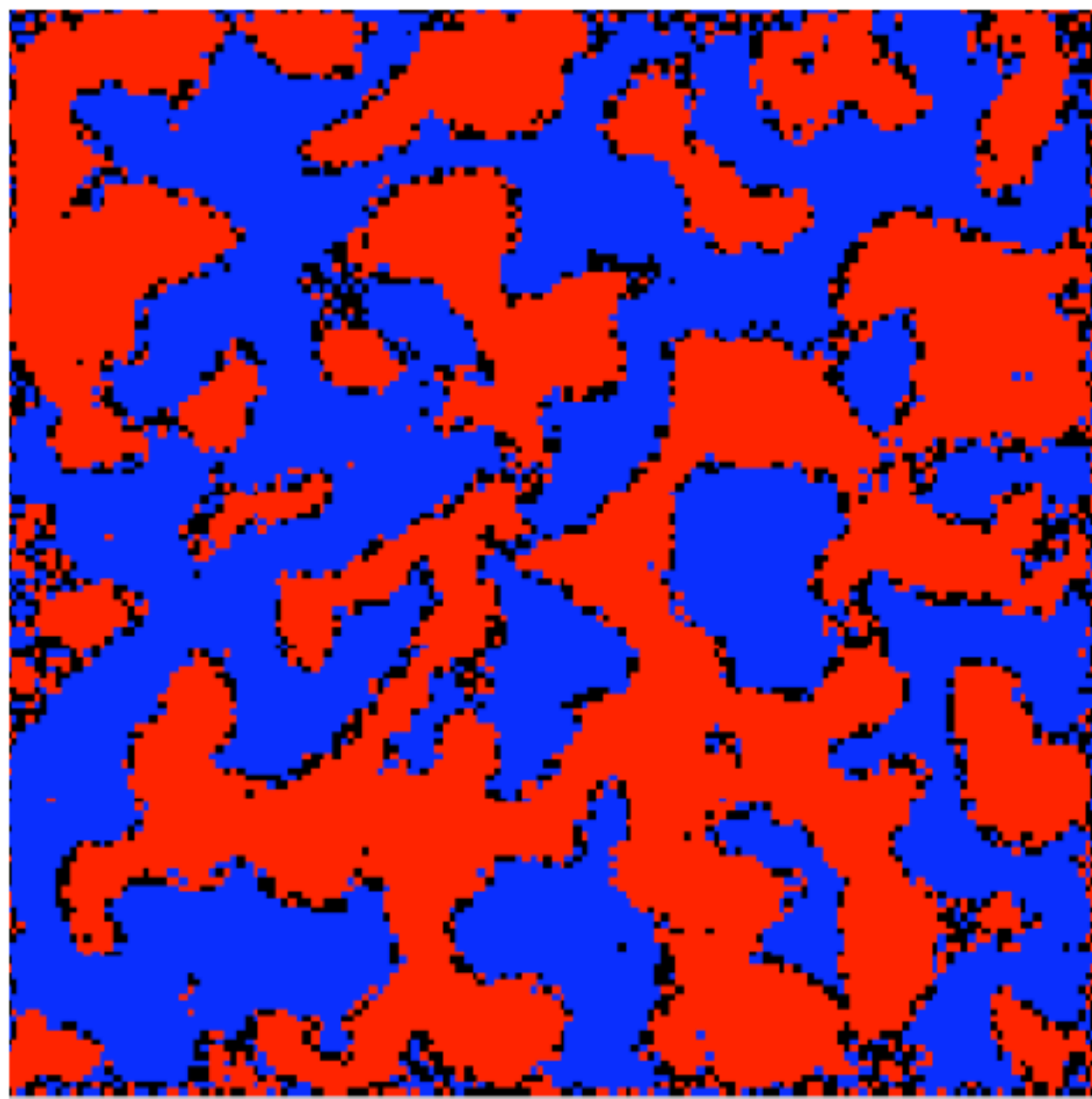


(c) After 350 steps

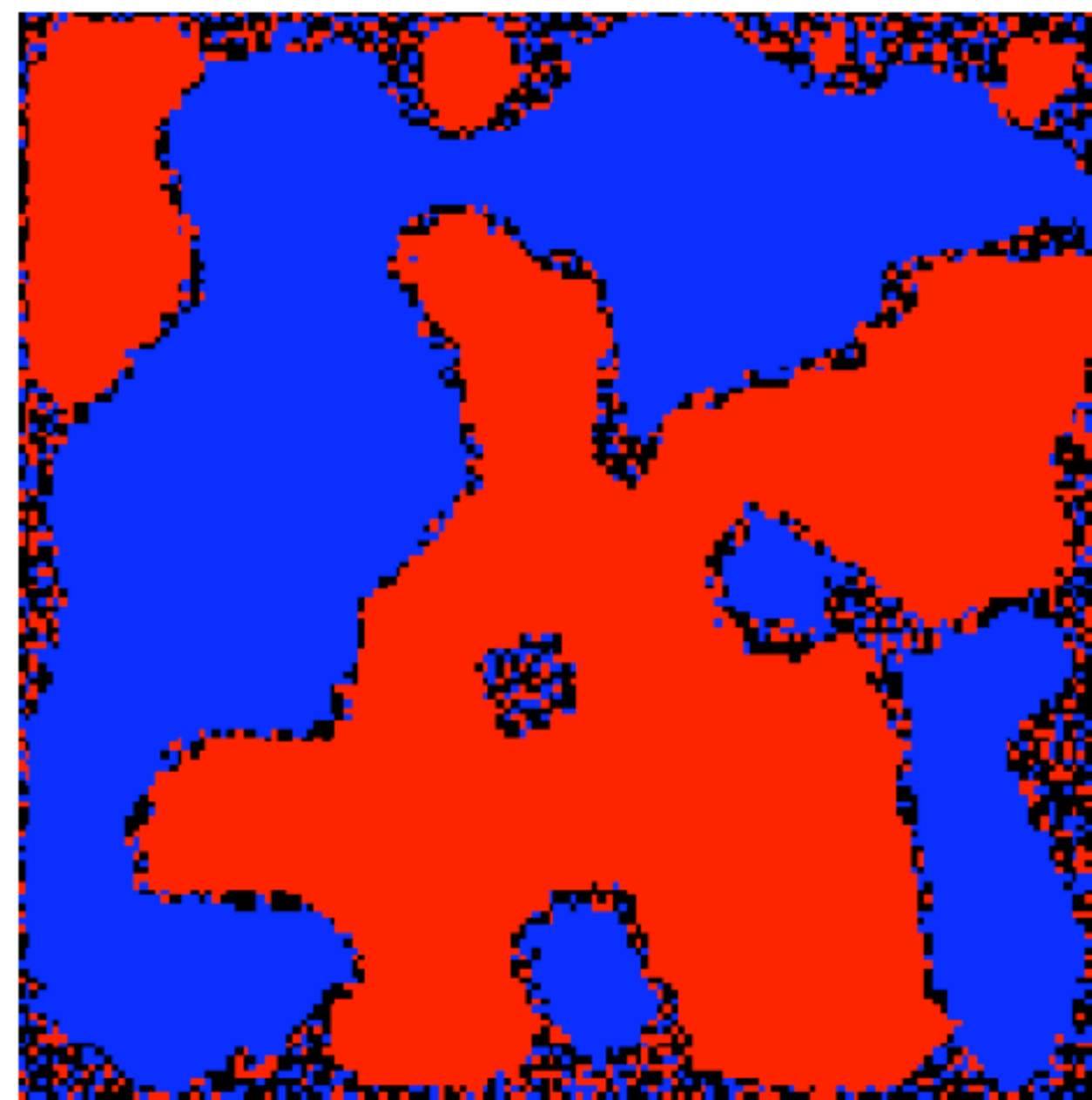


(d) After 800 steps

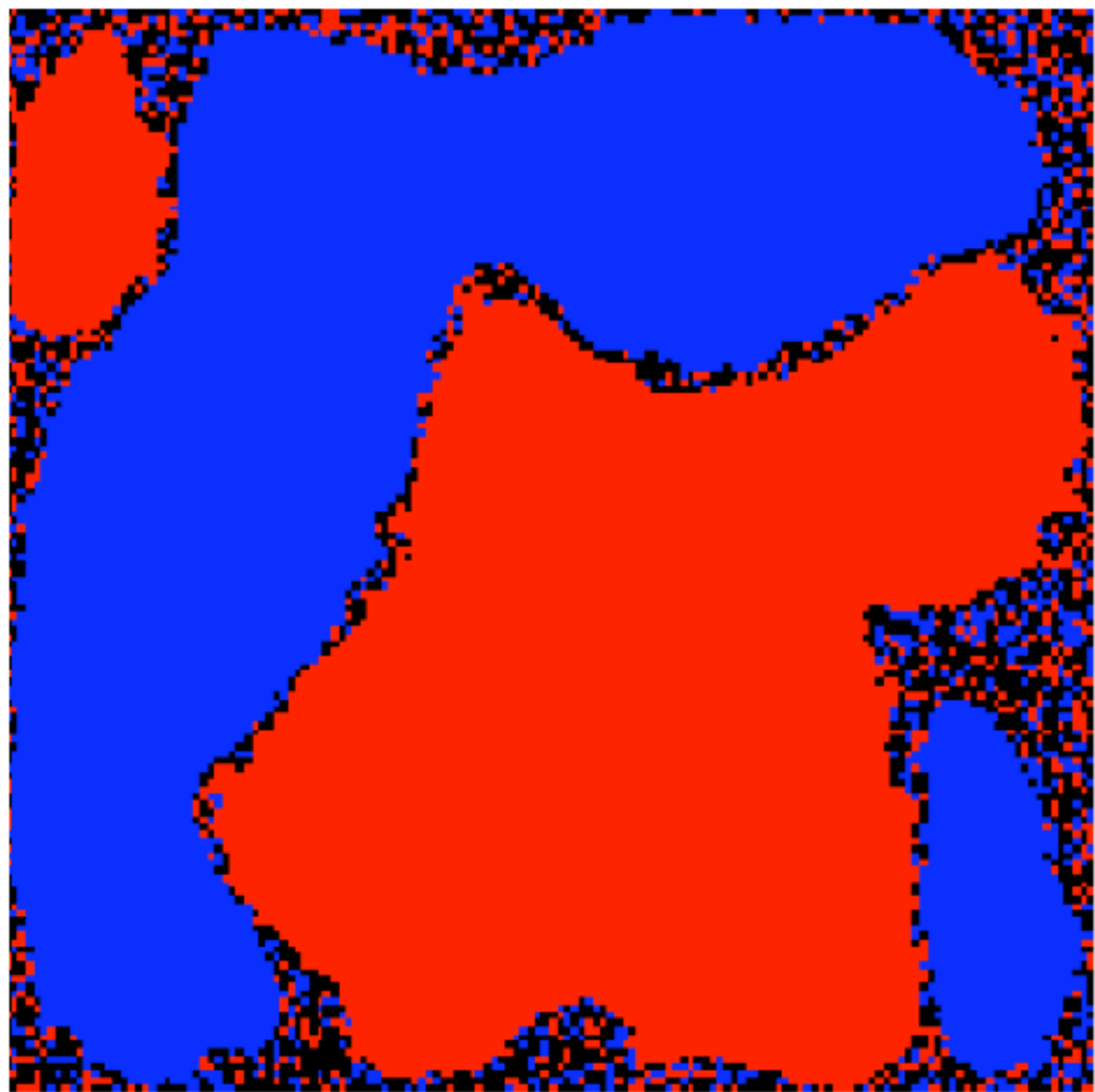
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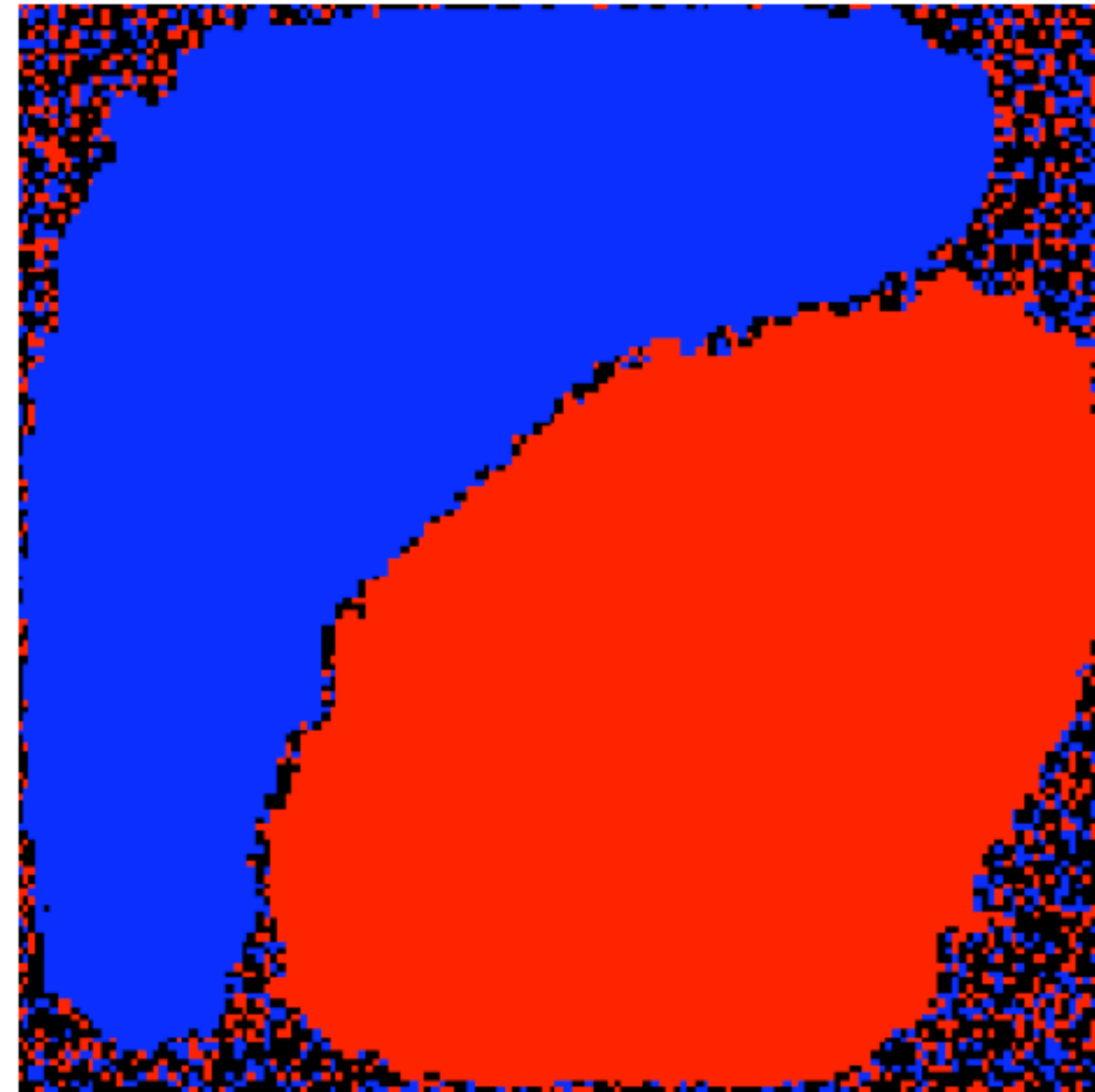
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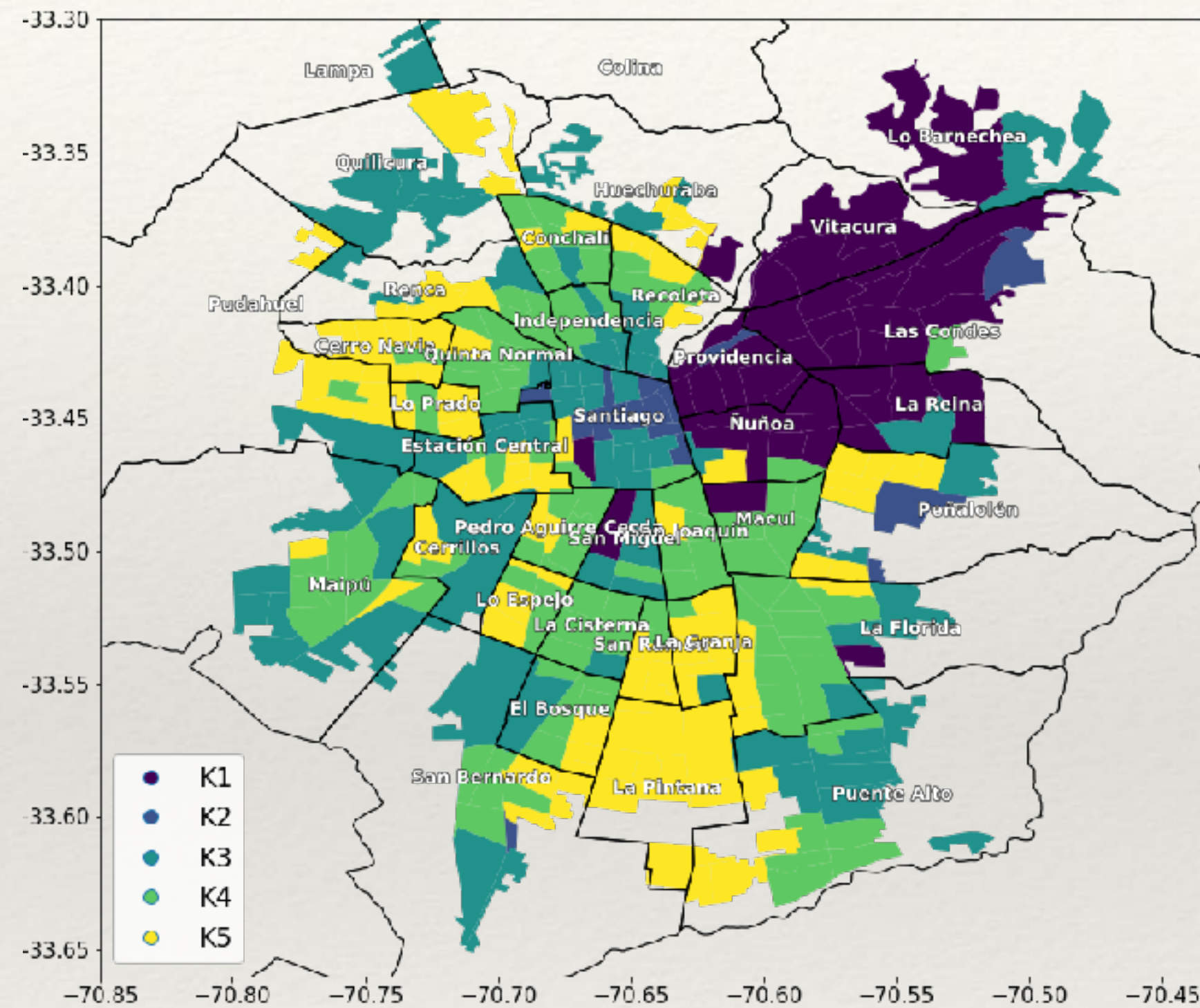
Segregation is
(trivially) amplified in
an intolerant society

Impacts of segregation

- ❖ Examples:
 - ❖ on news consumption
 - ❖ on outbreaks diffusion

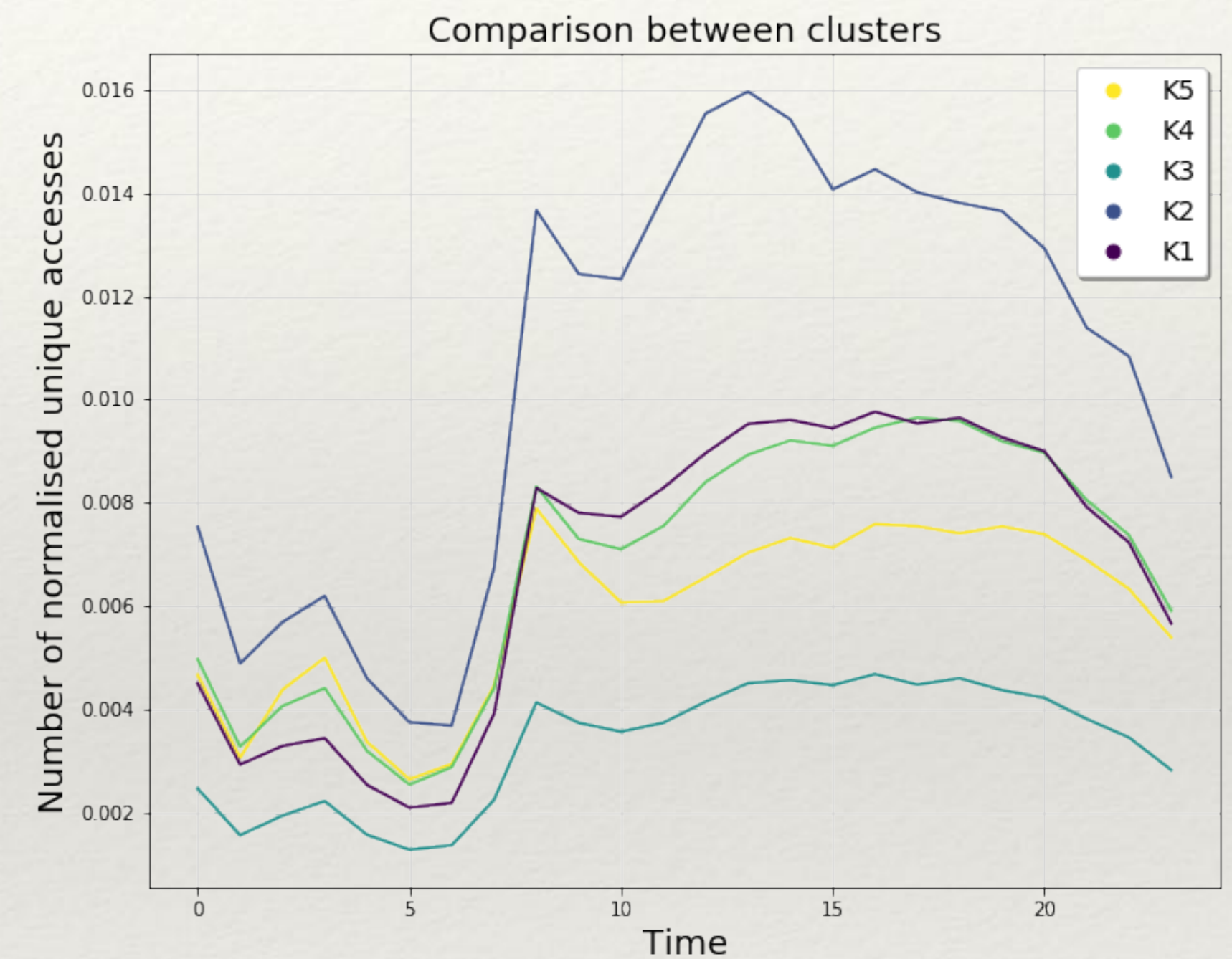
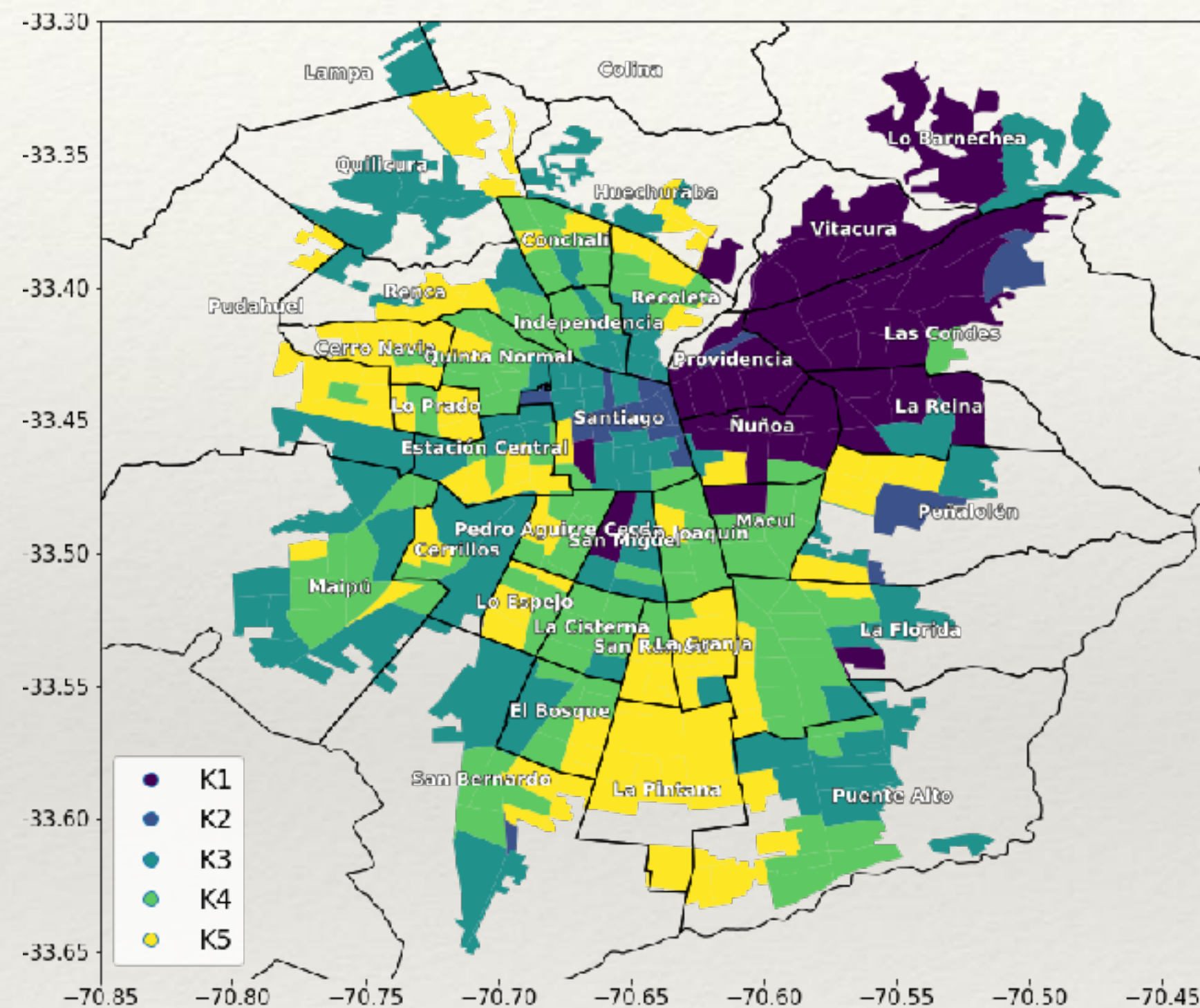
Segregation vs information consumption

Study of geo-located accesses to websites of news media revealed strong differences between different “classes” of the population of SCL.



Segregation vs information consumption

Study of geo-located accesses to websites of **news media** revealed strong differences between different “classes” of the population of SCL.



Segregation by age and virus transmission



Crowds take in the the cherry blossoms at Ueno Park on Saturday. Signs and barriers in the park are discouraging visitors from holding *sakura*-viewing parties. | YOSHIAKI MIURA

[COMMENTARY](#) / [JAPAN](#)

Why is Japan still a coronavirus outlier?

BY [OSCAR BOYD](#)

STAFF WRITER

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MAR 21, 2020

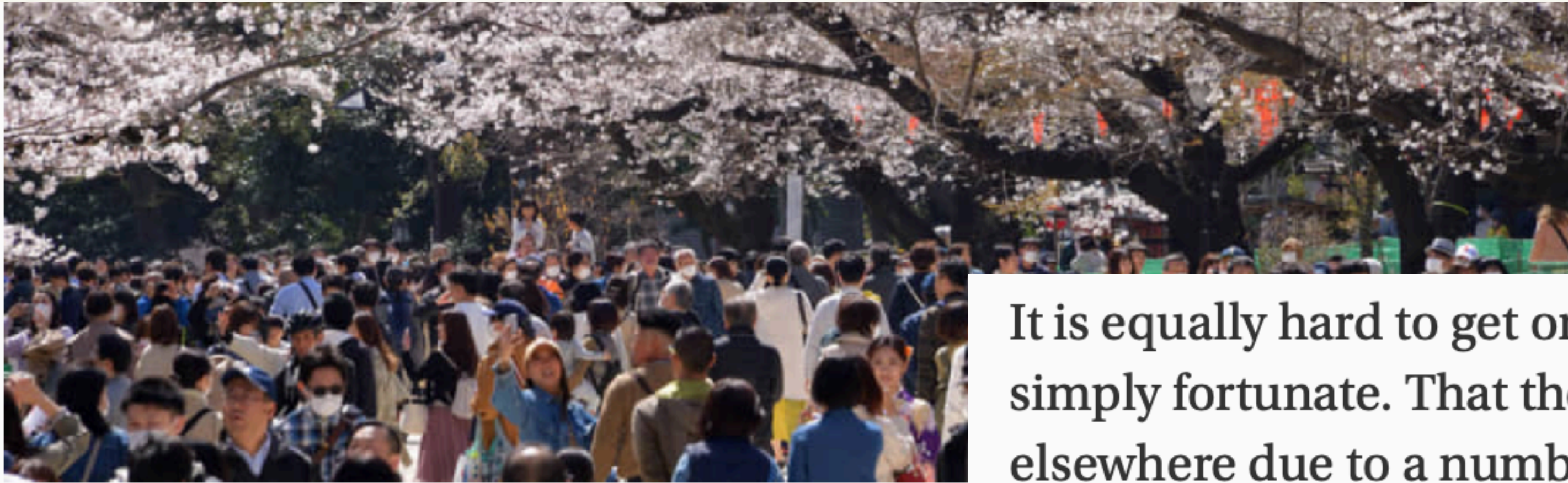
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It is equally hard to get onboard the second train of thought: that Japan is simply fortunate. That the disease here just hasn't spread in the way it has elsewhere due to a number of pre-existing conditions: relatively less social intimacy (bowing vs. shaking hands), an inclination to wear masks when sick that has existed since long before this coronavirus, [already high rates of isolation amongst the elderly](#), and what little voluntary self-isolation and social distancing there is has meant that Japan is flattening its curve without a truly active attempt to.

MAR 21, 2020

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Crowds take in the cherry blossoms as visitors from holding sakura-viewing parties.

COMMENTARY / JAPAN

Why is Japan still a coronavirus hot spot?

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In Italy, the first case was recorded on Feb. 23. Shortly after, 50,000 people were quarantined in a handful of towns in



hypothesis not supported by scientific evidences, yet!

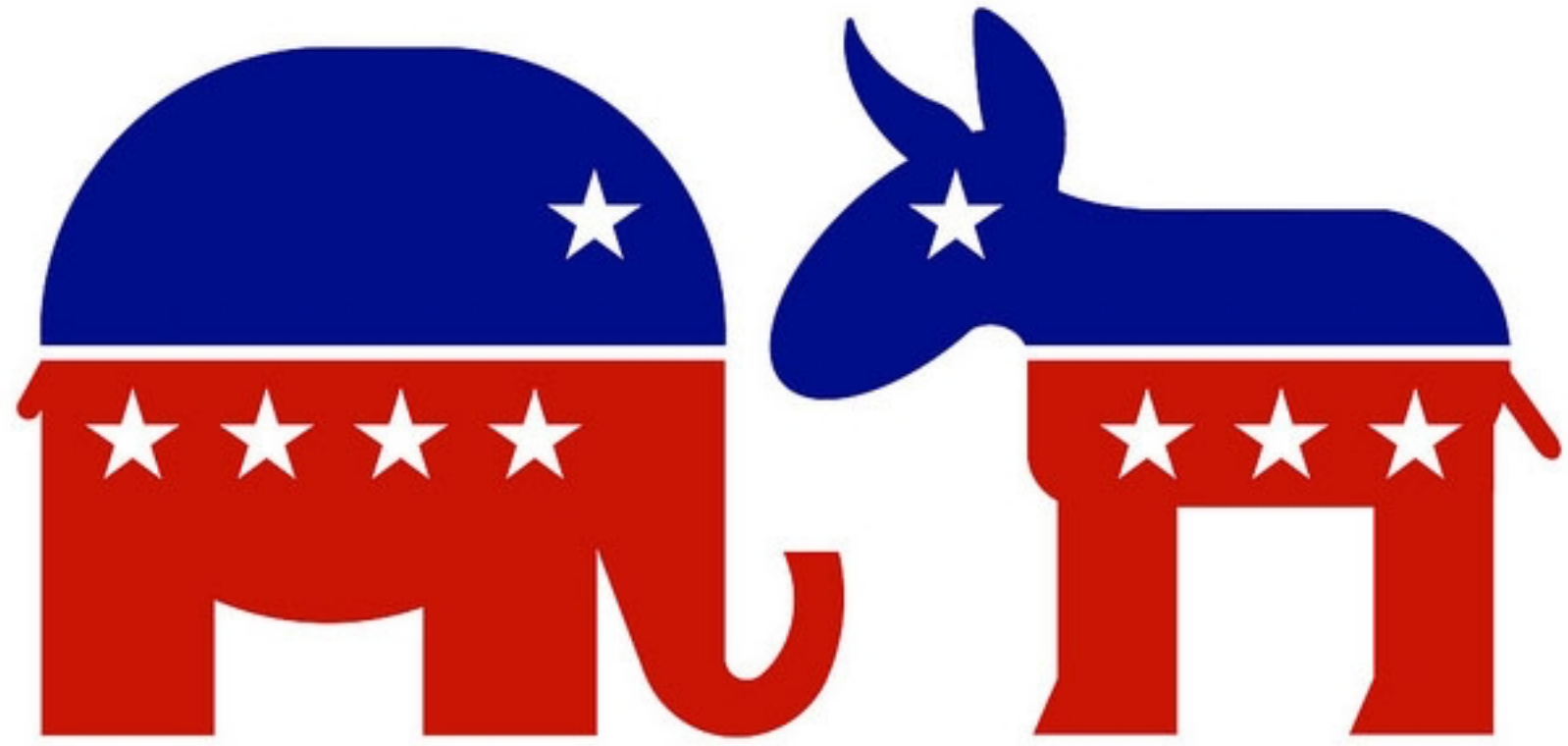
CLICK TO ENLARGE

thought: that Japan is spreading in the way it has: relatively less social to wear masks when us, [already high](#) the voluntary self- at Japan is flattening

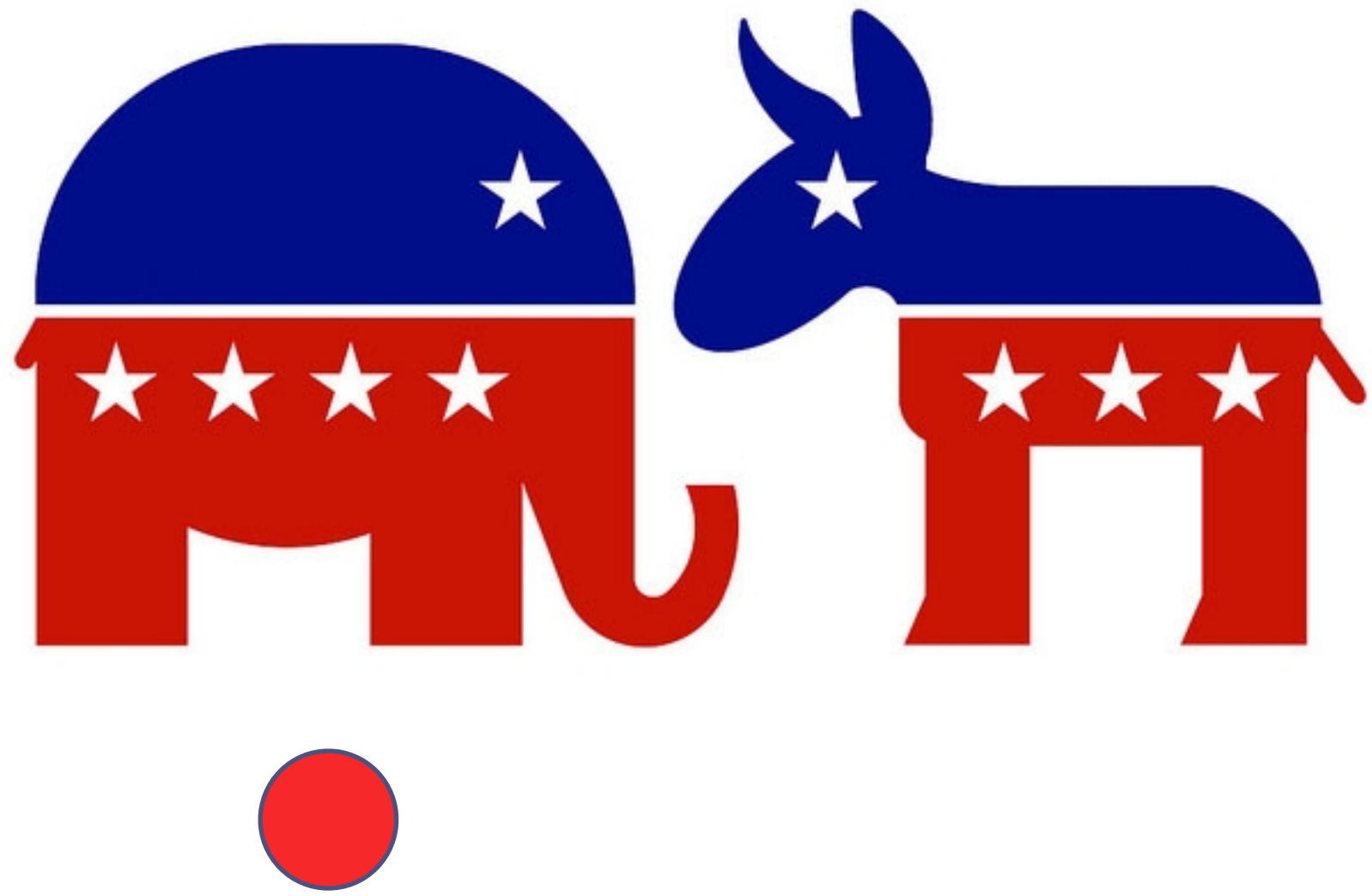
*“Polarization is both a state and a process. Polarization as a **state** refers to the extent to which opinions on an issue are opposed in relation to some theoretical maximum. Polarization as a **process** refers to the increase in such opposition over time.”*

– DiMaggio et. al, American Journal of Sociology, 1996

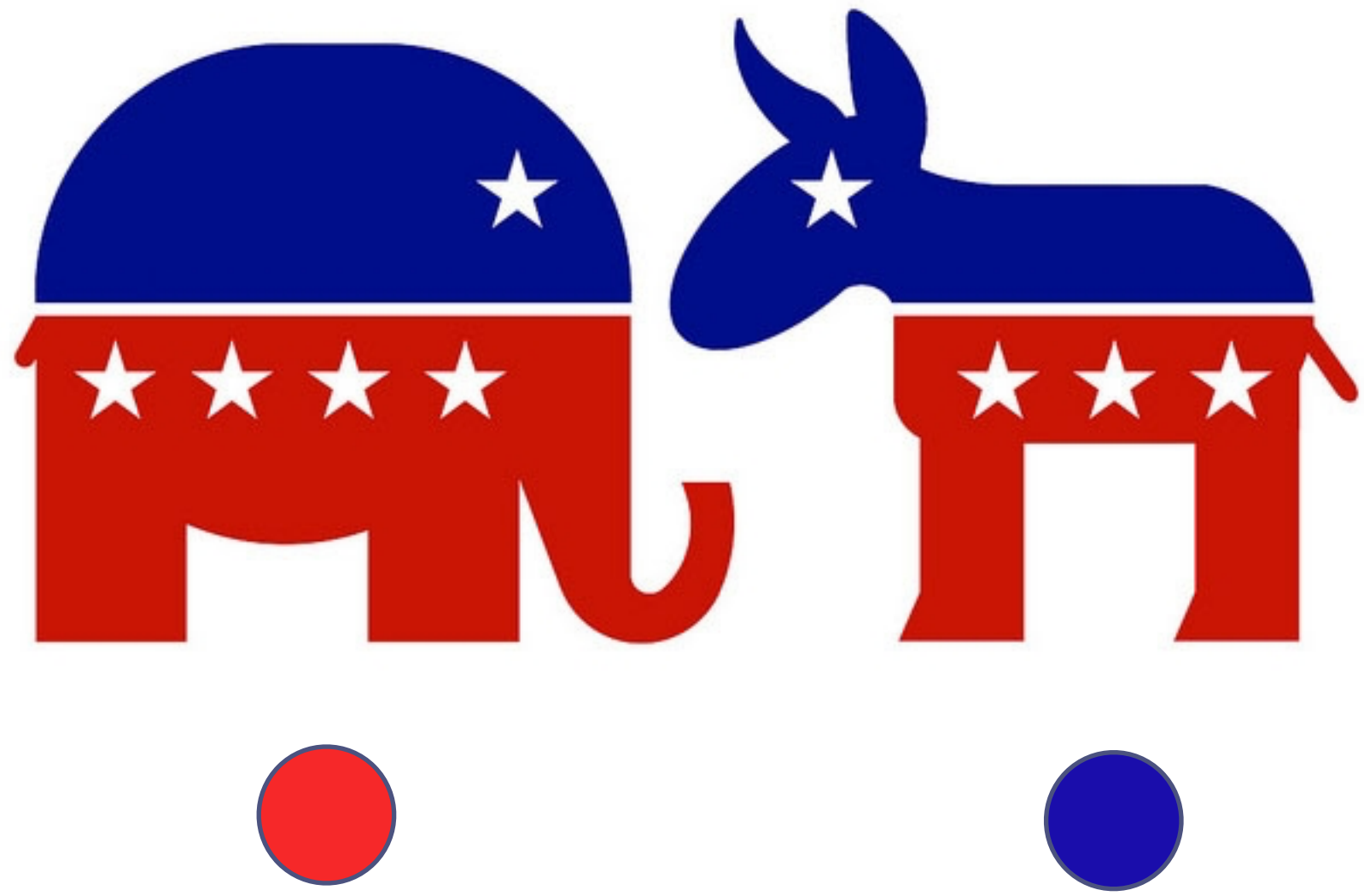
Polarization



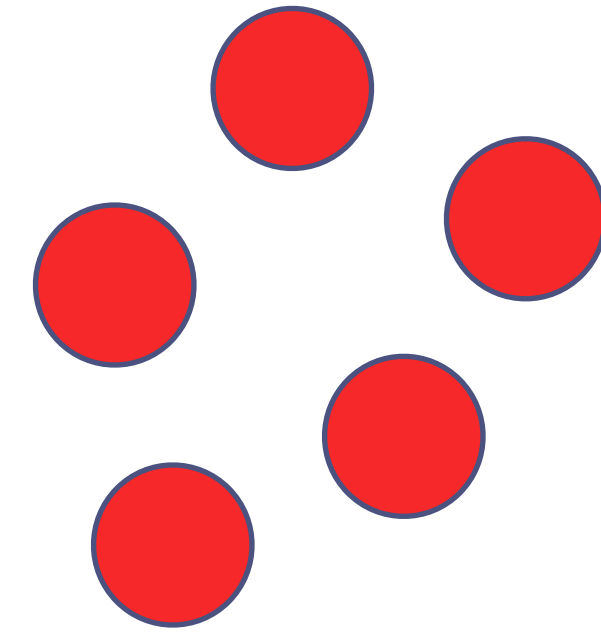
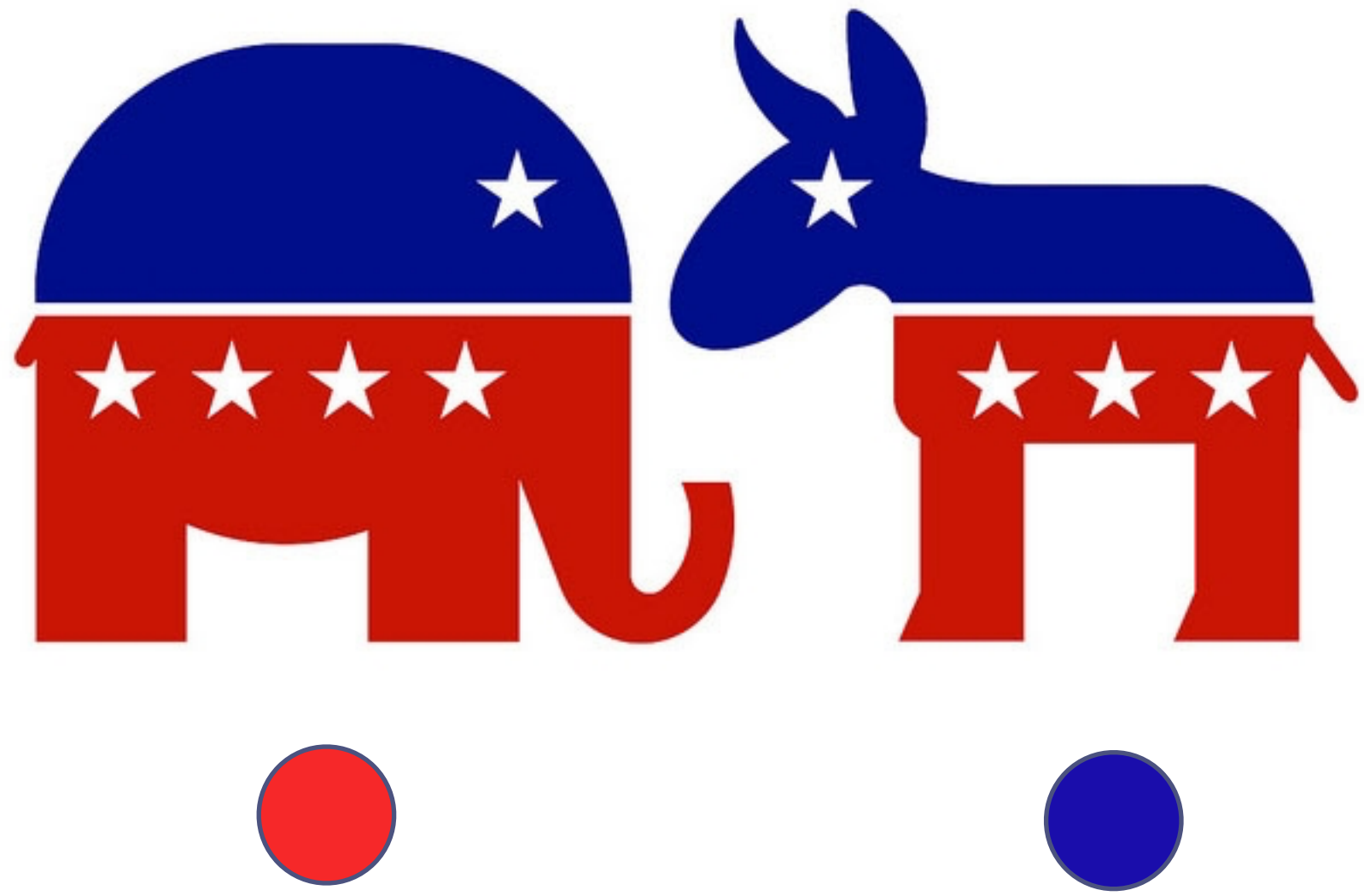
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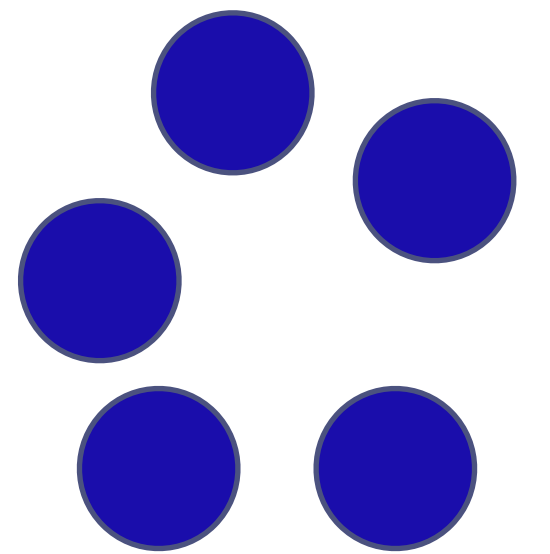
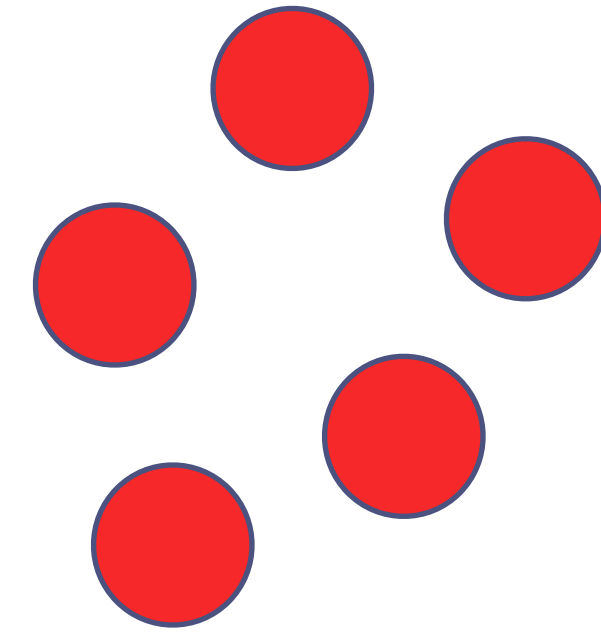
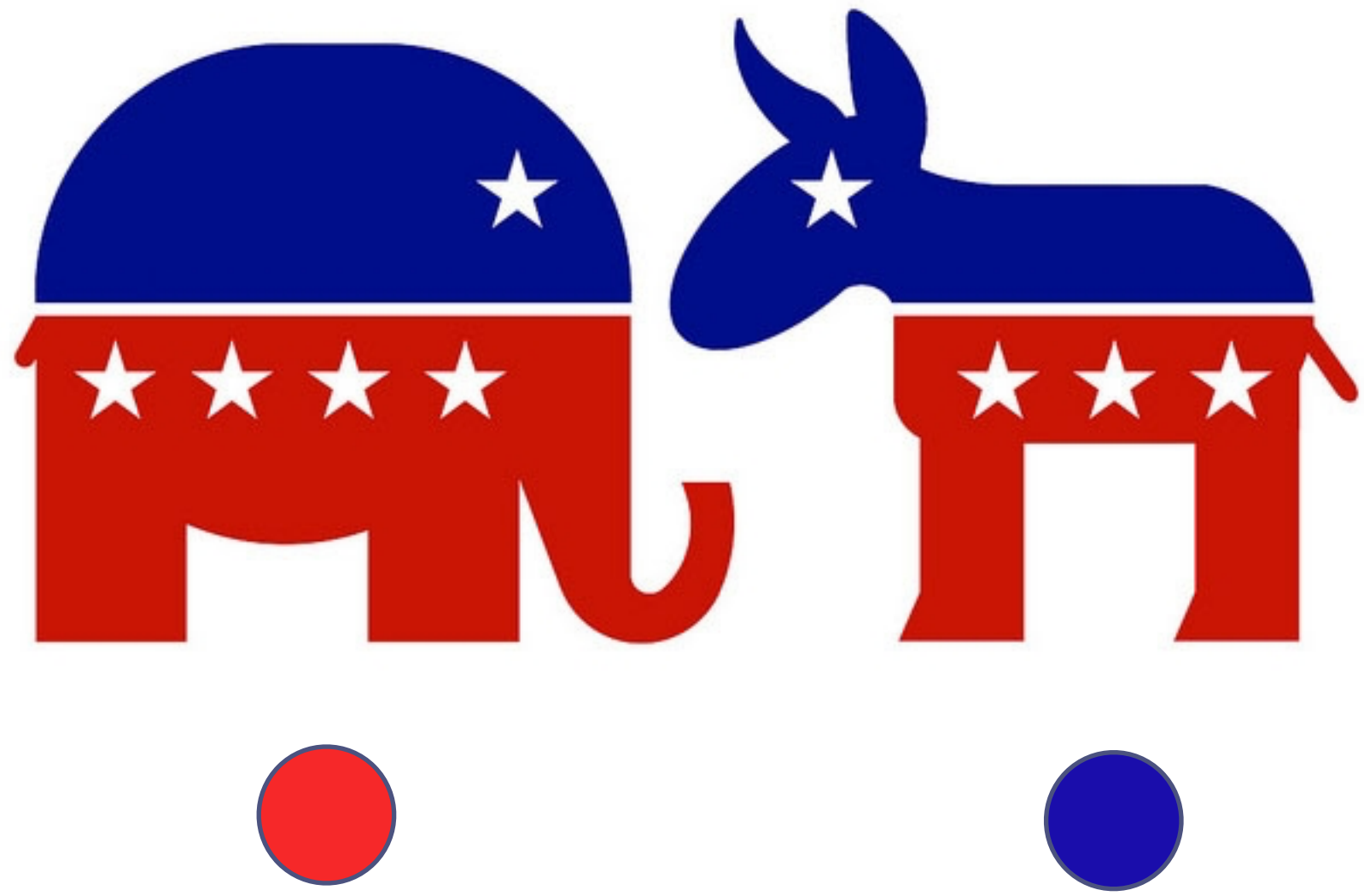
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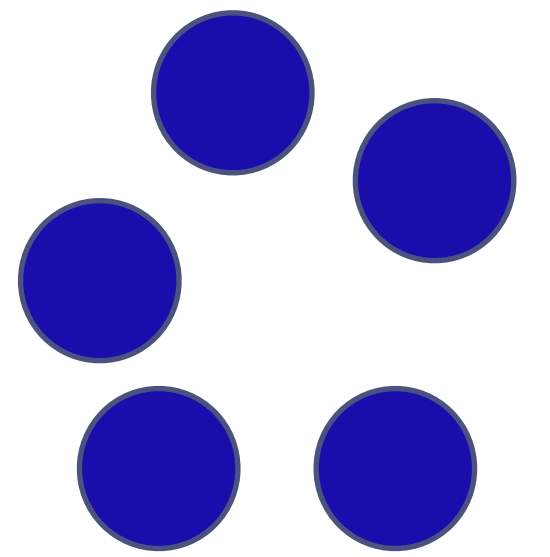
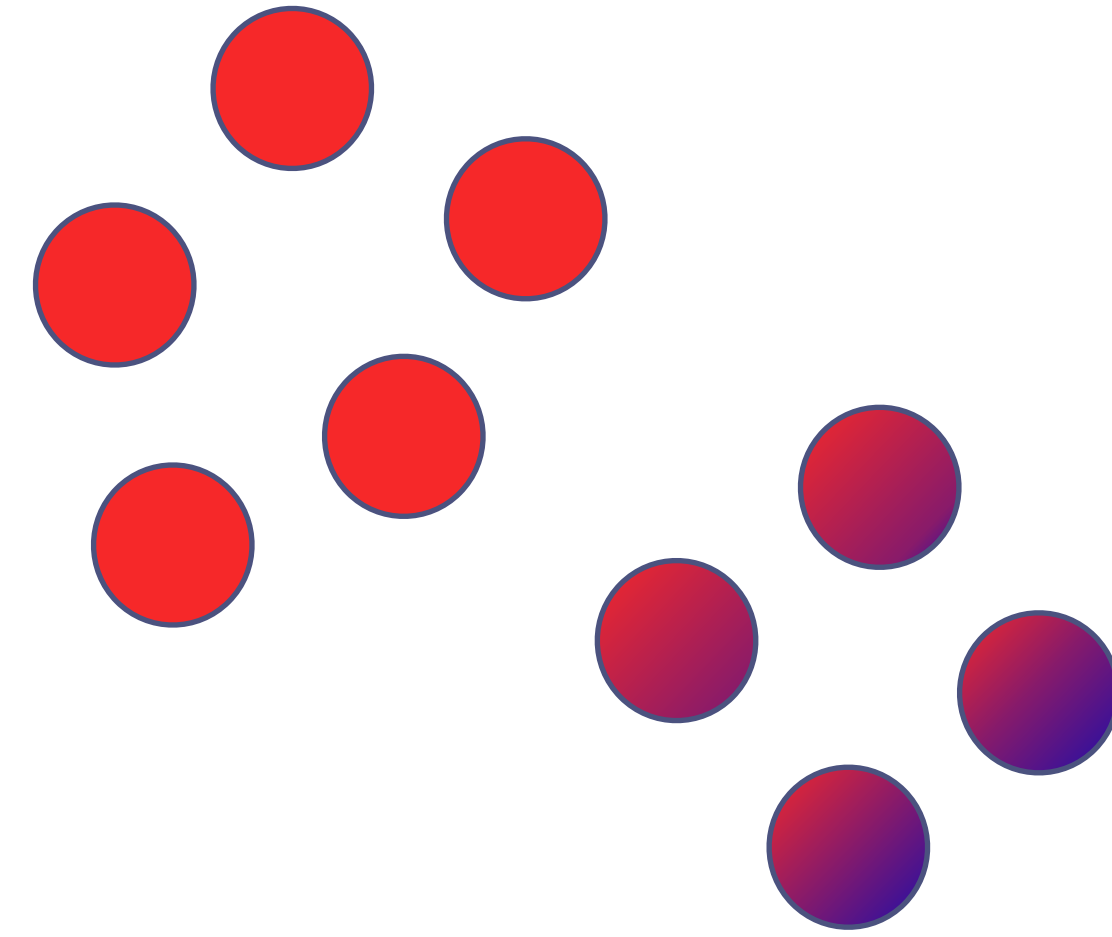
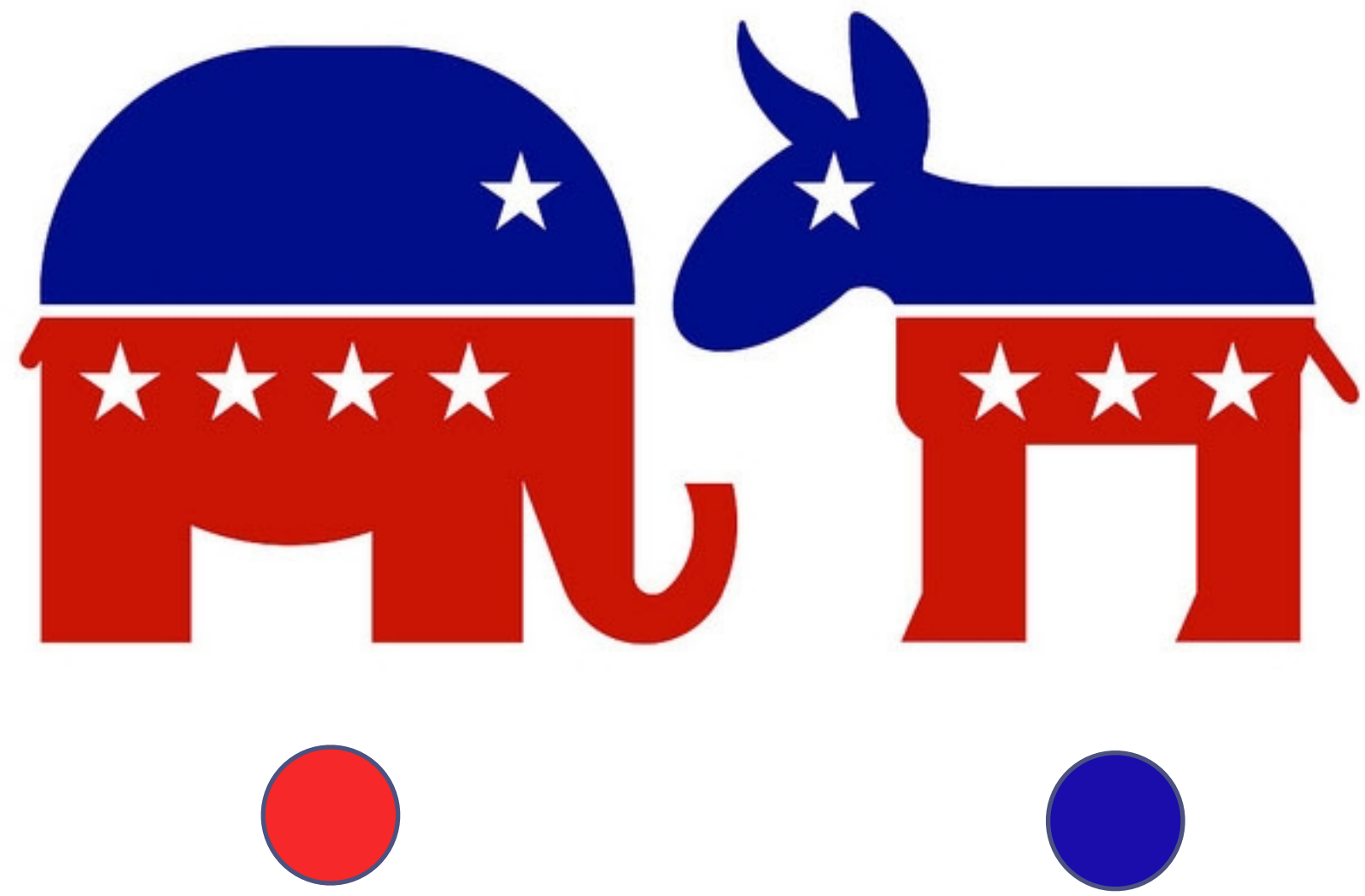
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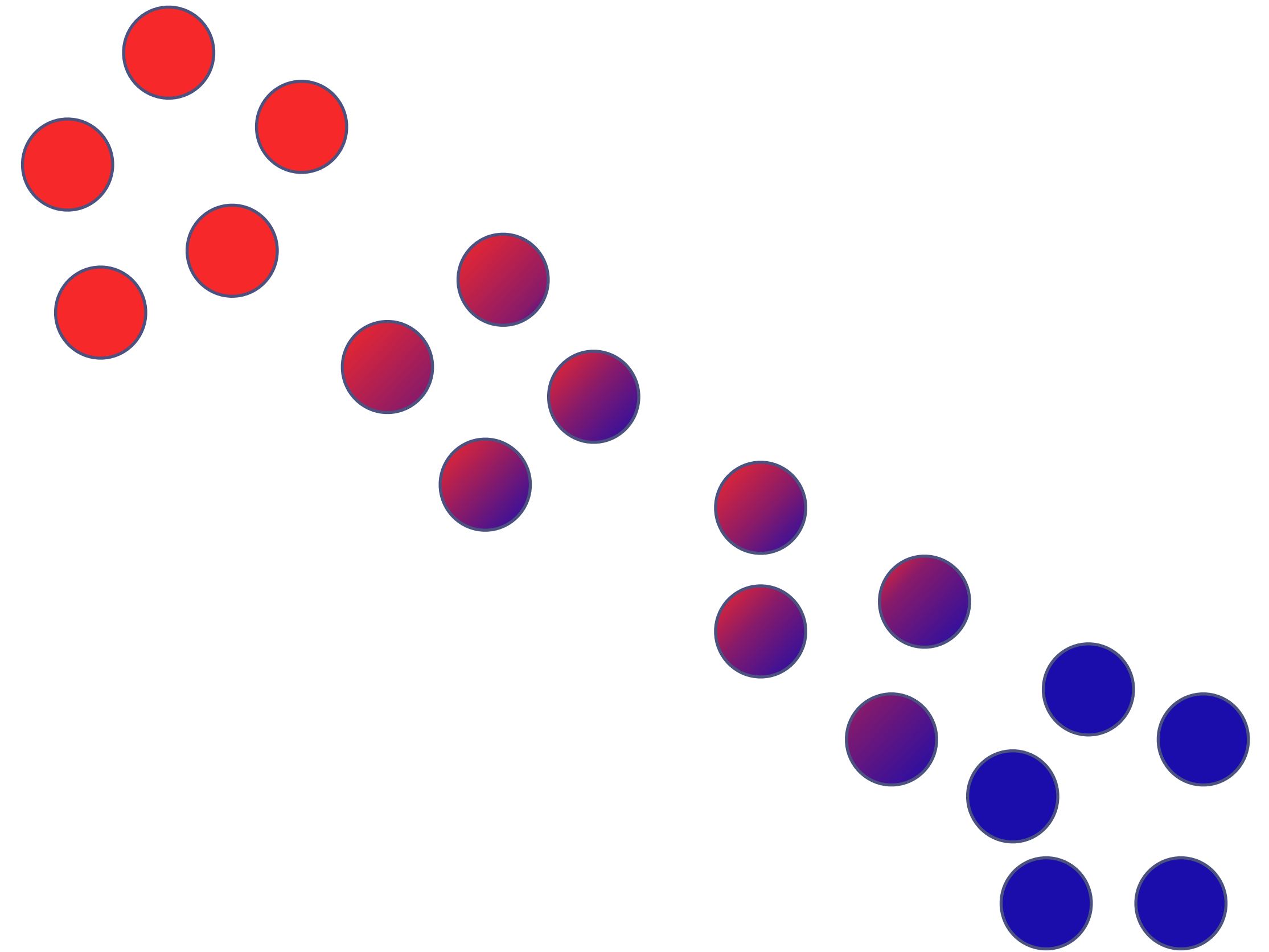
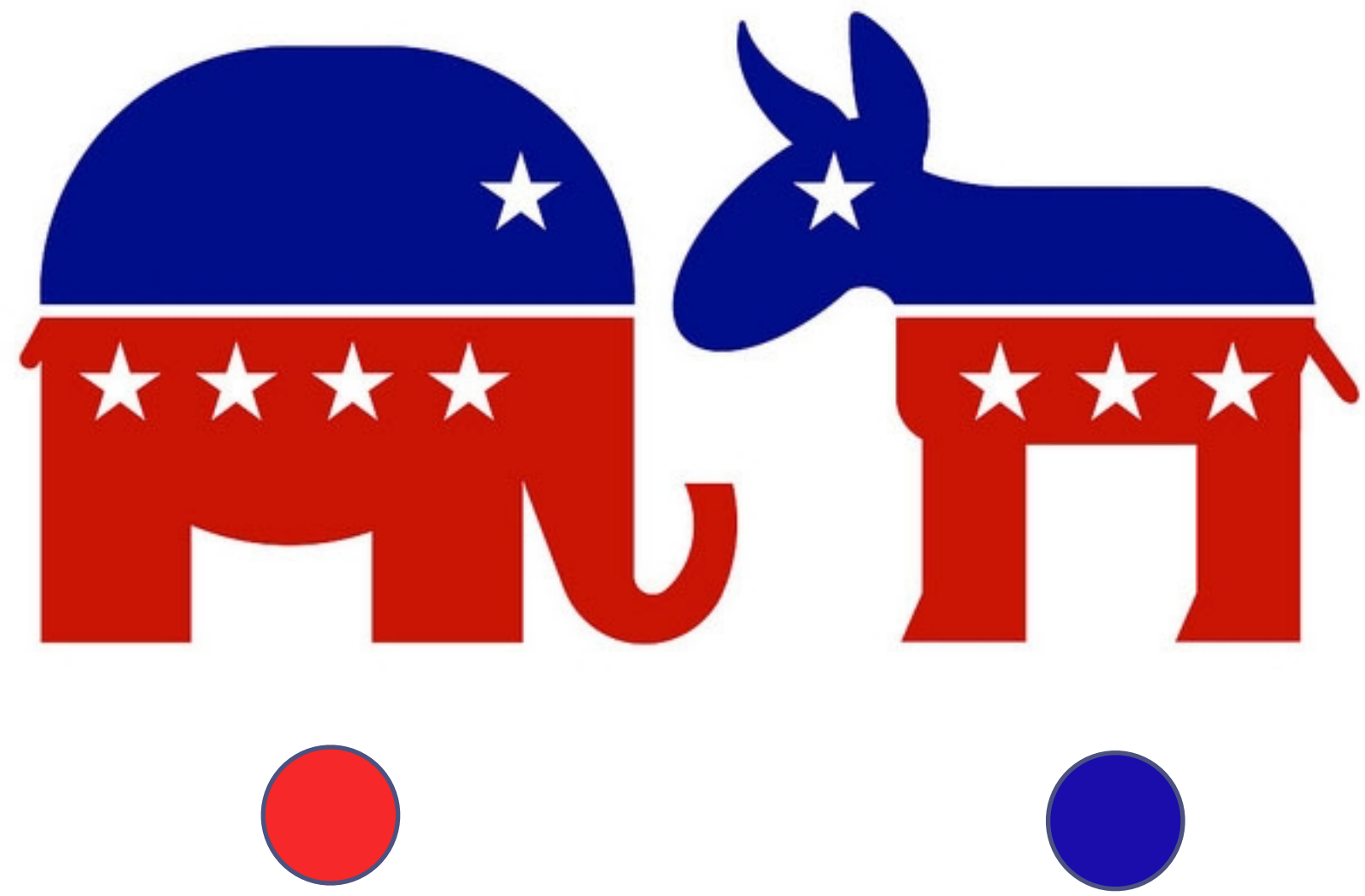
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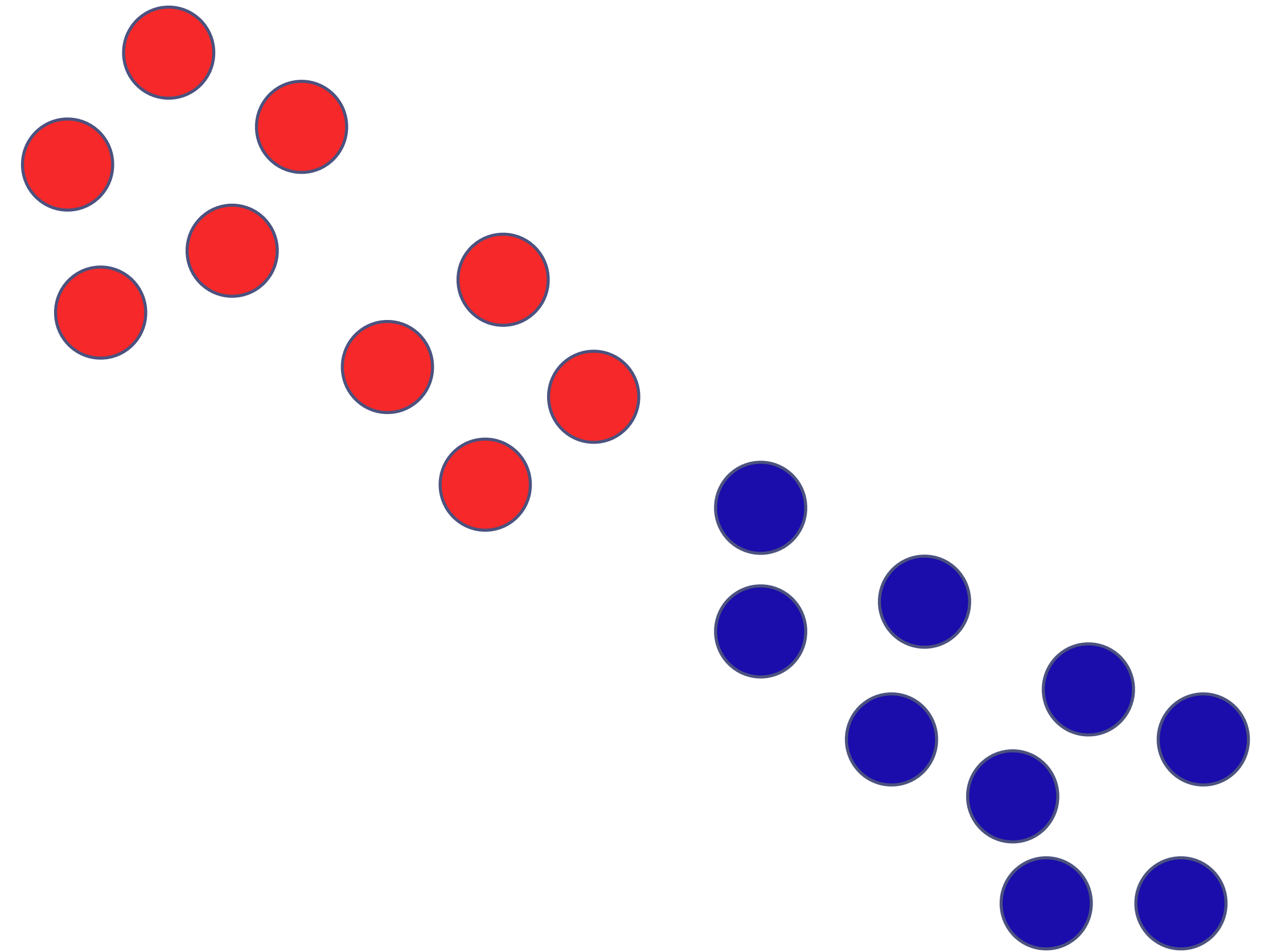
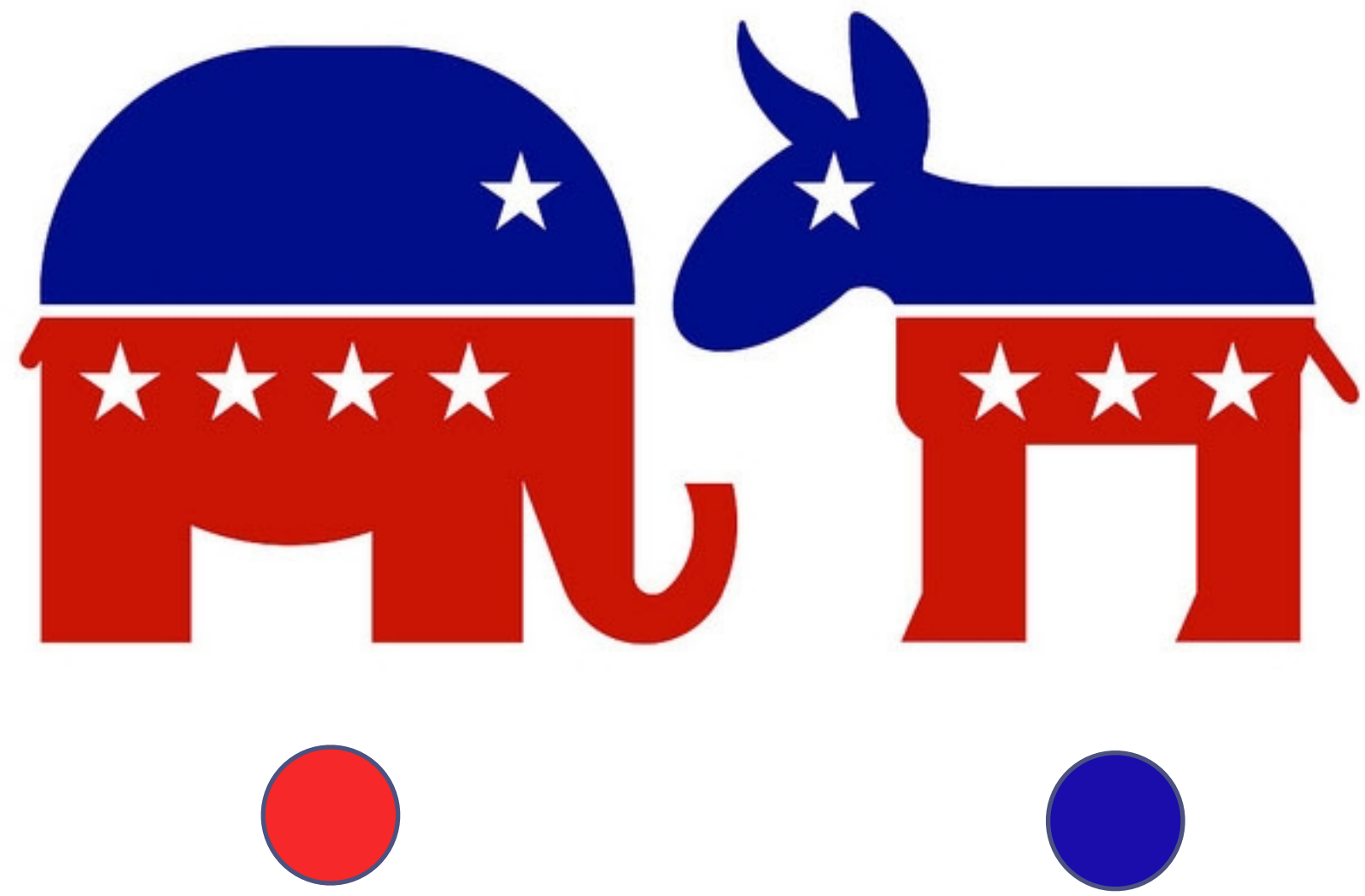
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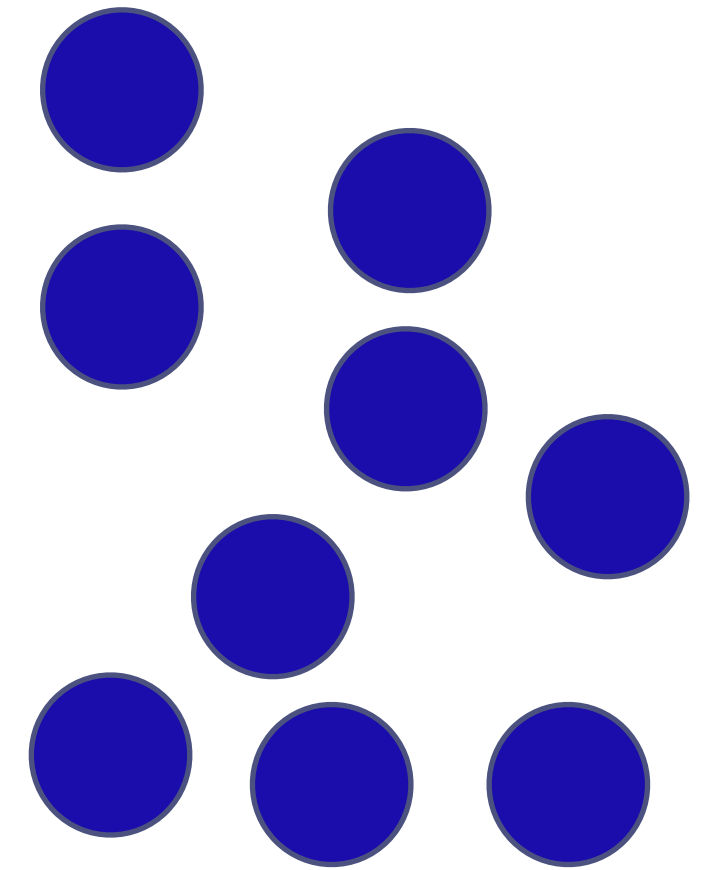
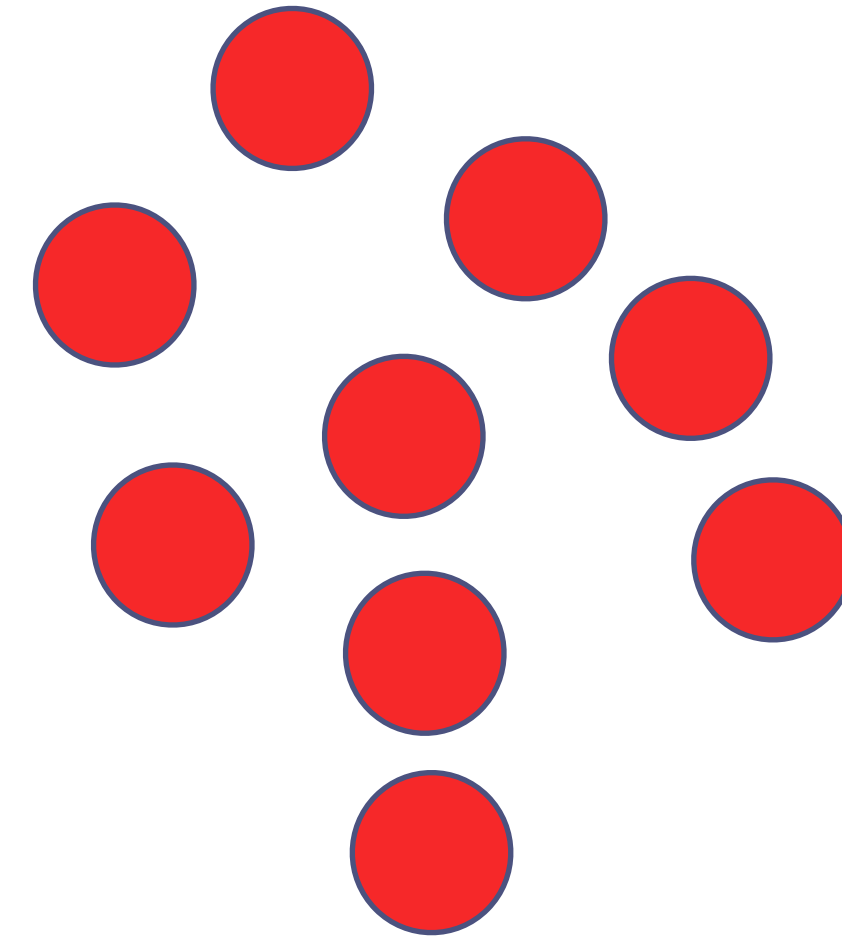
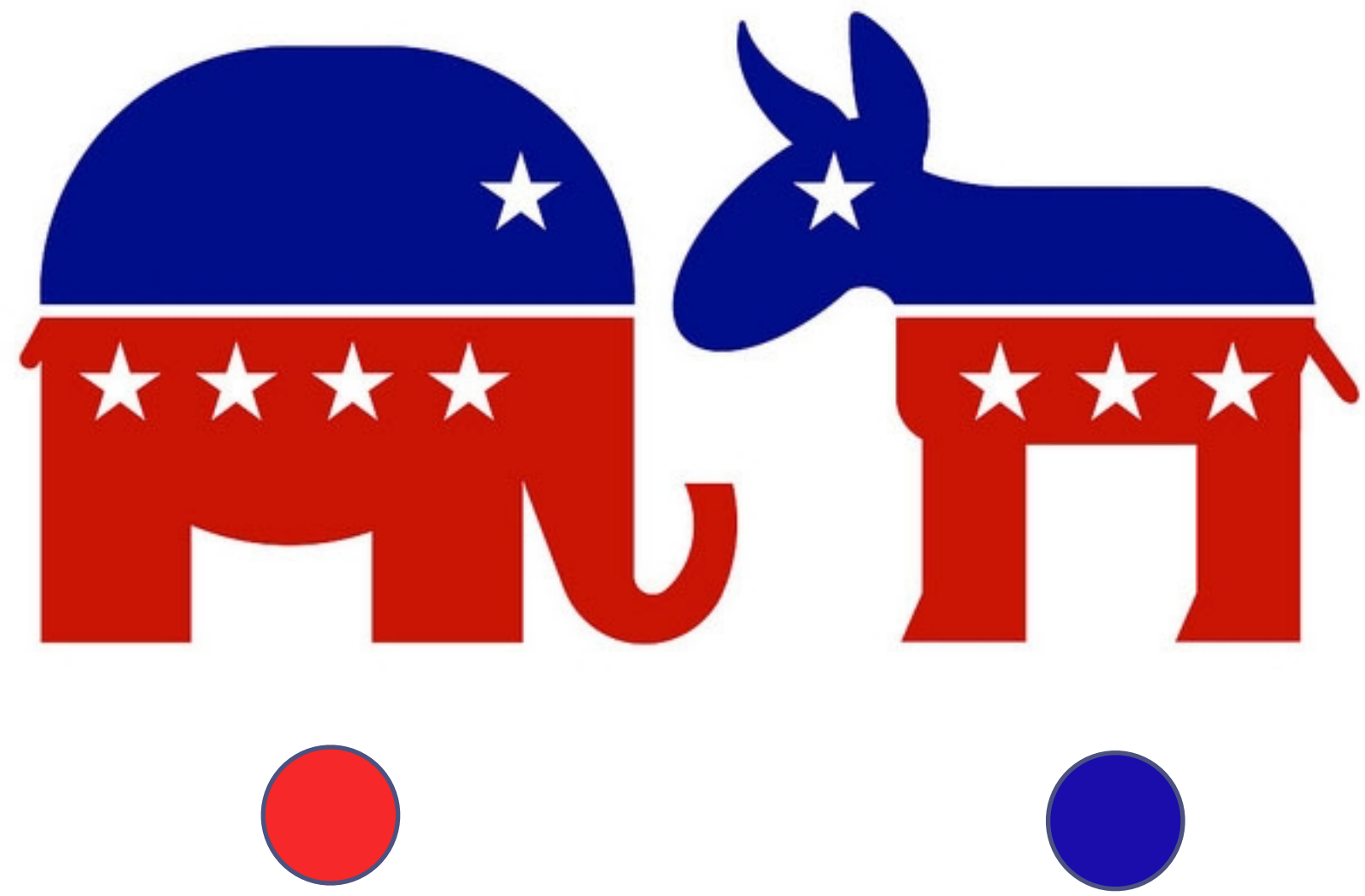
Polarization



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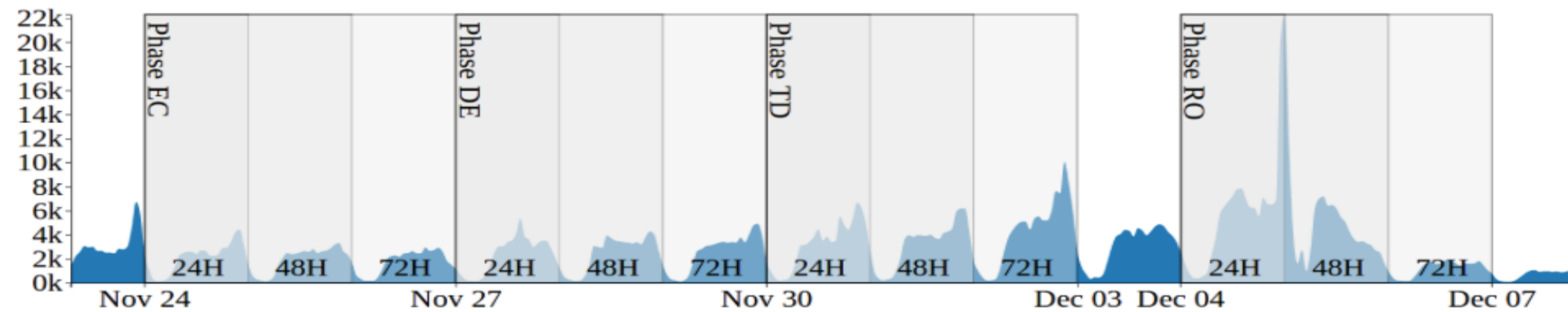


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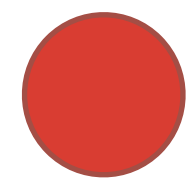
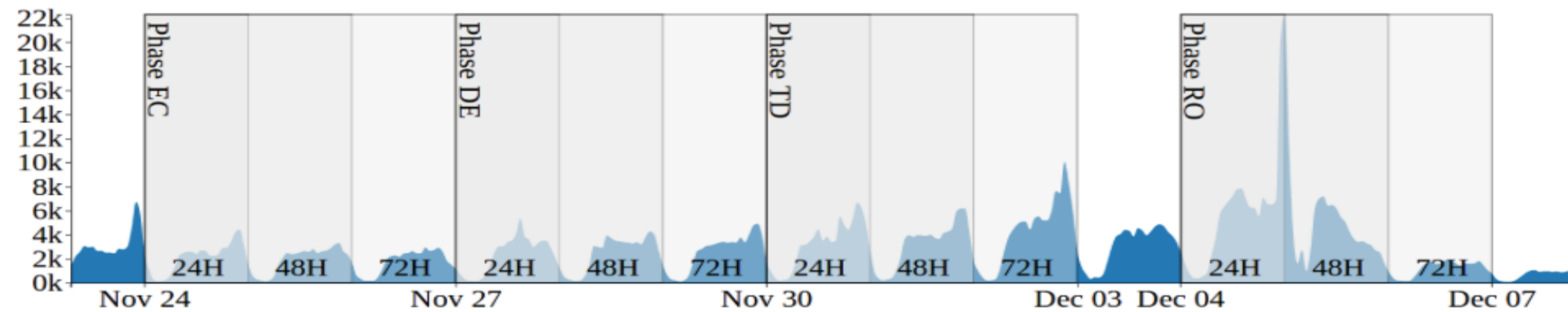
Italian 2016 Constitutional Referendum

Collected Tweets



Italian 2016 Constitutional Referendum

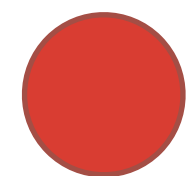
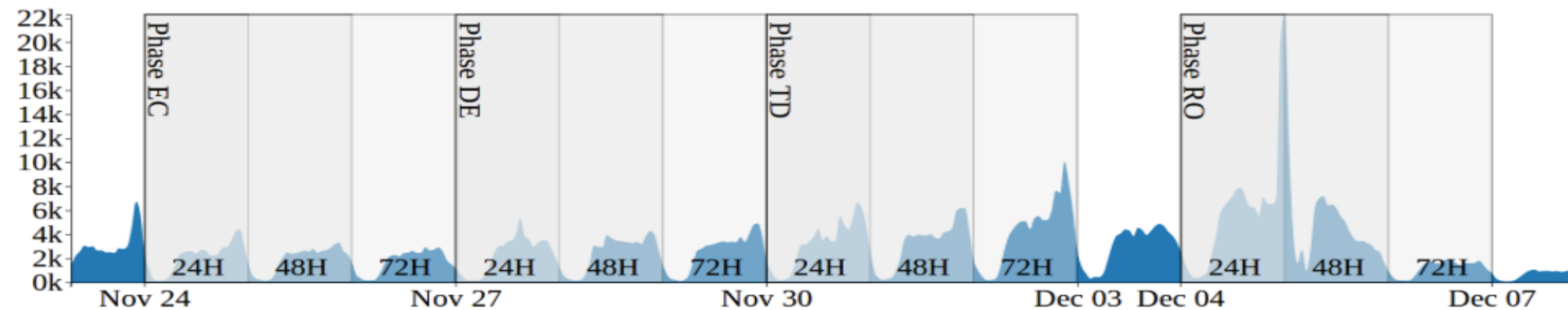
Collected Tweets



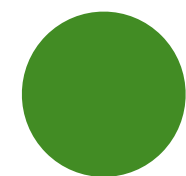
stance detected as **AGAINST**

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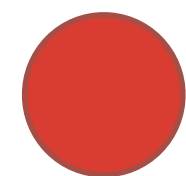
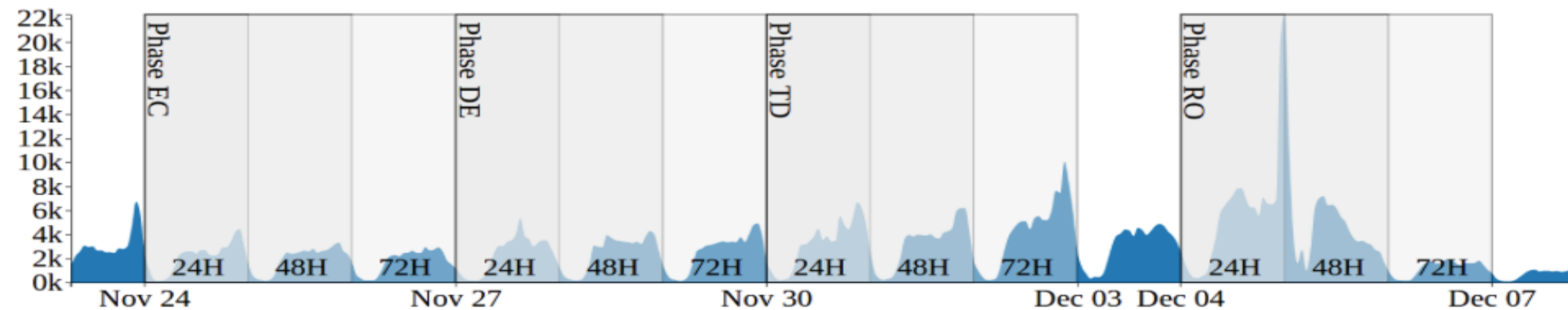
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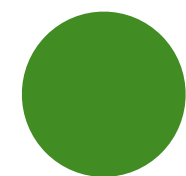
stance detected as **IN FAVOR**

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stance detected as **AGAINST**



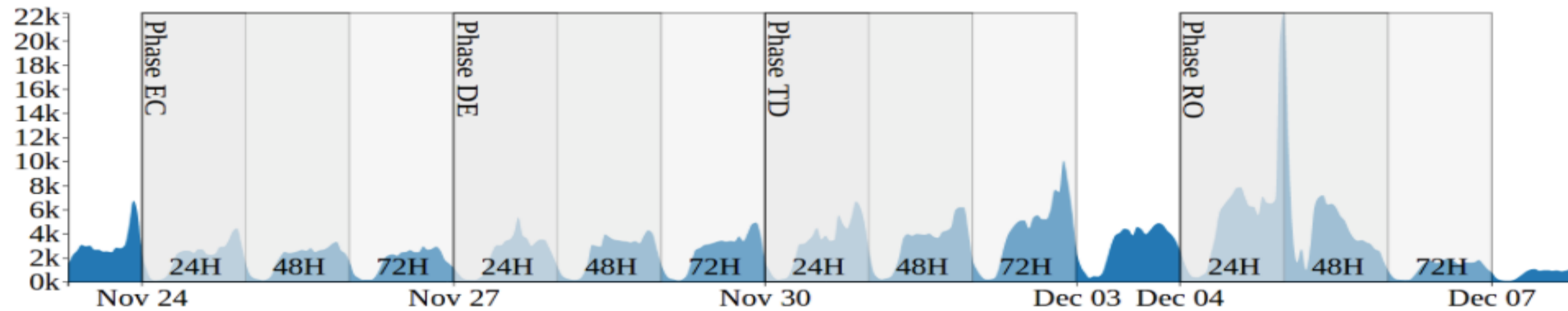
stance detected as **IN FAVOR**



stance detected as **NONE**

Italian 2016 Constitutional Referendum

Collected Tweets



-  stance detected as **AGAINST**
-  stance detected as **IN FAVOR**
-  stance detected as **NONE**

EC



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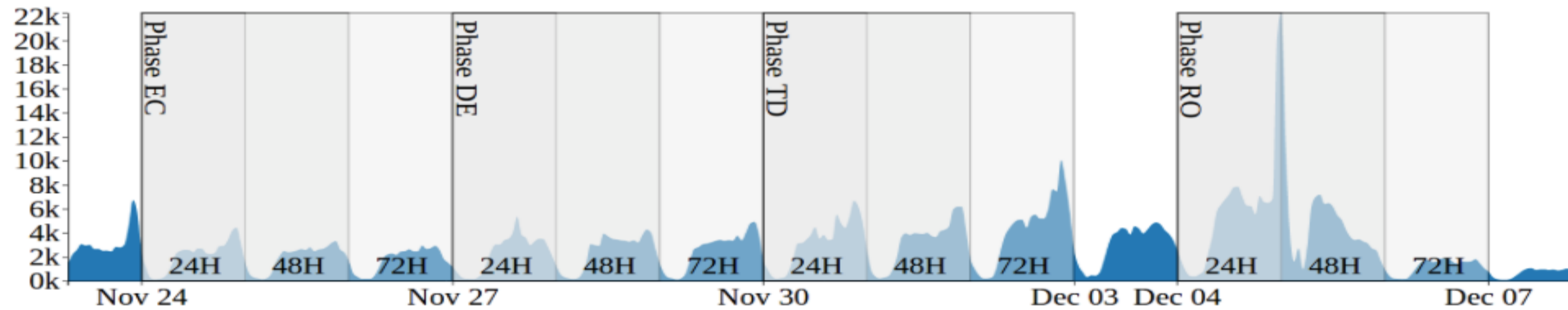


Retweet Network

strong signal of
homophily

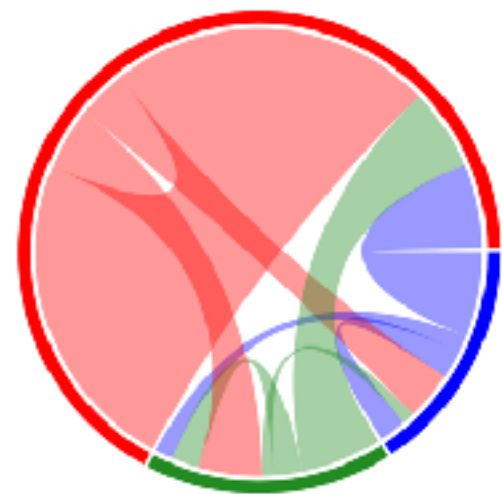
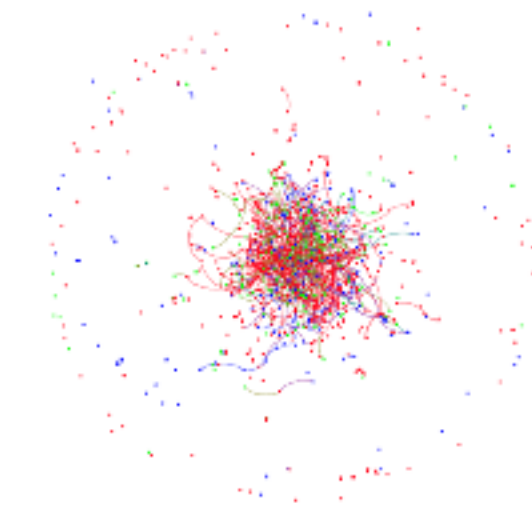
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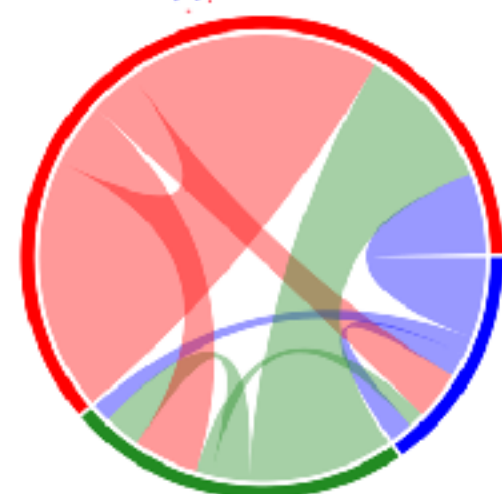
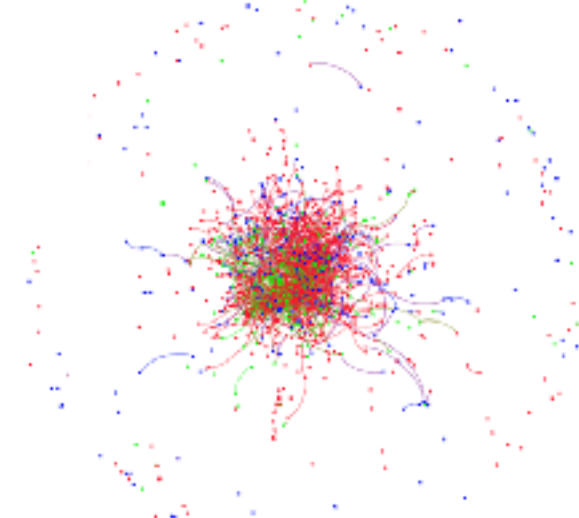


-  stance detected as **AGAINST**
-  stance detected as **IN FAVOR**
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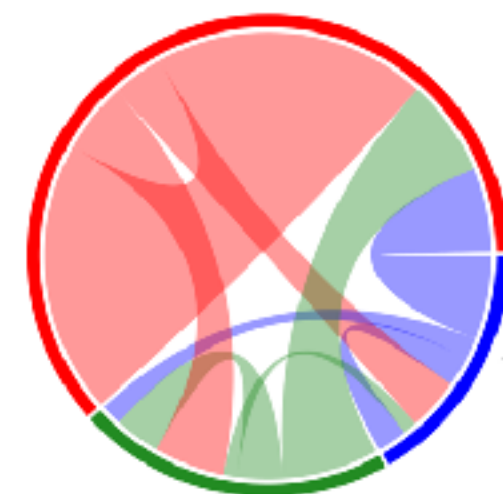
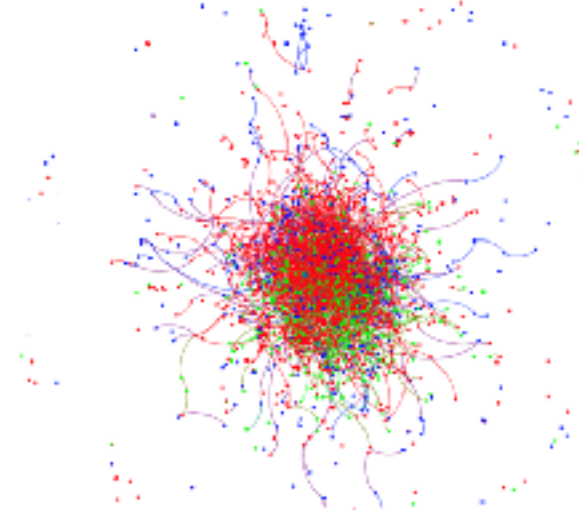
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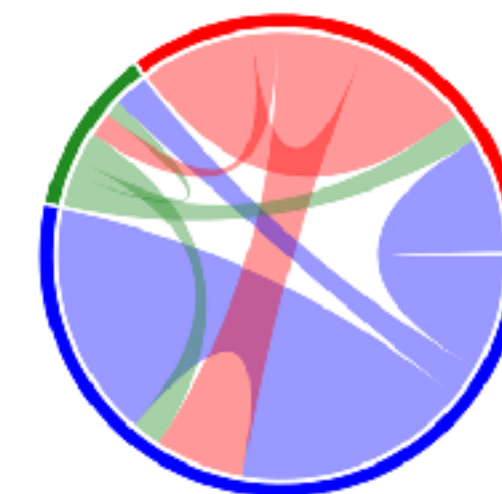
DE



TD



RO



Reply-to Network

signal of **inverse homophily**

Issues with studying polarization

- ❖ **State:** difficult to detect
 - ❖ e.g., NLP based techniques as "*stance detection*" are great, but errors prone
- ❖ **Process:** difficult to observe
 - ❖ e.g., opinions can mitigate or polarize over time, but people do not necessarily express them
- ❖ Polarization by **selection** and by **influence**
 - ❖ do I get along with people that share my opinion, or I am influenced by people with whom I get along? or both processes are at interplay?
- ❖ "**Social contagion**" is more rational than we may think...

Conformity experiment and group influence



Asch Conformity Experiment

<https://www.youtube.com/watch?v=NyDDyT1lDhA>

The strange case of Lajello

Analyzing social network with a bot



Analyzing social network with a bot

- ❖ Anobii was a social networks for book lovers



The screenshot shows a user profile for "Claudia" (♀️♠️♣️). The profile includes a "Follow" button, a "Message" button, and a "Taste compatibility: UNKNOWN" section with the text "Add more books to match". Below this are filter options: "By Progress", "By Authors", "By Languages", and "By Tags". A "Groups" section lists several groups with their member counts. At the bottom, there is a "Shoutbox" with a "See all" link and a "Leave a comment" input field.

The main content area displays a "Books (126)" shelf. The shelf is organized into three rows of book covers. The first row includes "Paths Beyond Ego", "Joseph Campbell: Pathways to Bliss", "Karen Miller: Empress", "Kyra" by Carol Gilligan, and "The Portable Jung". The second row includes "Official Guide to the NEW TOEFL", "Integral Life Practice", "Ken Wilber: Integral Spirituality", "The Unfolding Now", and "Space User Inquiry". The third row includes "Diamond Heart", "Brilliance", "Lisa Jewell", "A.S. Byatt: The Children's Book", and "The Girl with the Dragon Tattoo" by Stieg Larsson. Each book cover has a star rating below it.

On the right side of the shelf, there are two sections: "Friends more" and "Neighbors more". The "Friends" section lists users: reyda, Aglaja, Walter, bethulla, and zeromeno. The "Neighbors" section lists users: Simonetta, *MM*, Ste, Moonray, and virinthesky.

Analyzing social network with a bot

- ❖ Anobii was a social networks for book lovers
- ❖ Scraping users' profiles from the Web was admitted



A screenshot of an Anobii user profile for a user named "Claudia A.". The profile includes a profile picture, a bio stating "Female, 38, Single. Torino, Italy", and buttons for "Follow" and "Message". Below this is a "Taste compatibility: UNKNOWN" section with the text "Add more books to match". There are four filter buttons: "By Progress", "By Authors", "By Languages", and "By Tags". A "Groups" section lists several groups with their member counts. At the bottom, there is a "Shoutbox" with a "See all" link and a "Leave a comment" input field. The main content area shows a "Books (126)" section with a search bar and a grid of book covers. The books are arranged in three rows. To the right of the book grid is a "Friends" list with names like "reyda", "Aglaja", "Walter", "bethulla", and "zeromeno", and a "Neighbors" list with names like "Simonetta", "*MM*", "Ste", "Moonray", and "virinthesky".

Analyzing social network with a bot

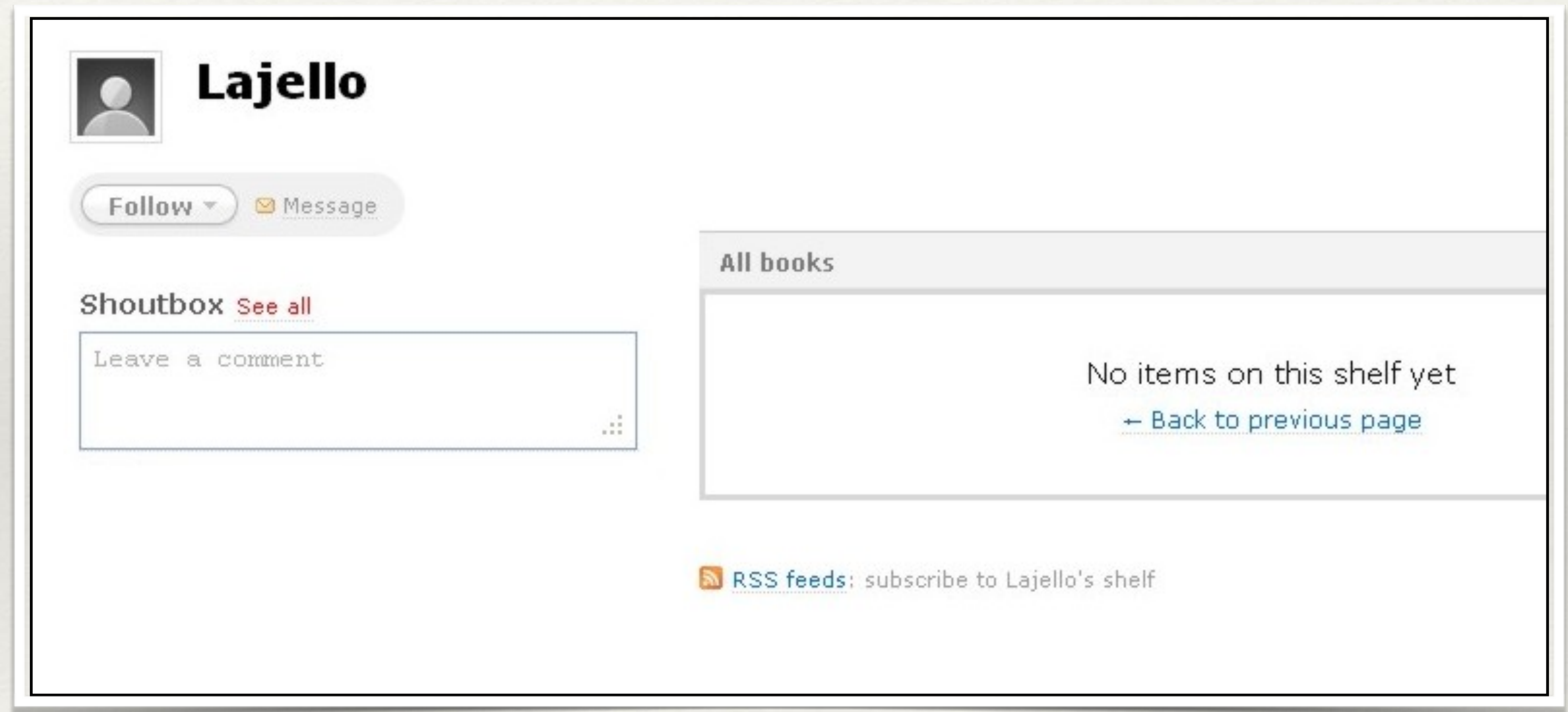
- ❖ Anobii was a social networks for book lovers
- ❖ Scraping users' profiles from the Web was admitted
- ❖ Users' libraries and their links were collected periodically



A screenshot of an Anobii user profile for "Claudia A.". The profile includes a user picture, name, gender (Female, 38), and location (Torino, Italy). It shows a "Follow" button, a "Message" button, and a "Taste compatibility: UNKNOWN" section with a link to "Add more books to match". Below this are sorting options: "By Progress", "By Authors", "By Languages", and "By Tags". A "Groups" section lists several groups with member counts. At the bottom, there is a "Shoutbox" with a "See all" link and a "Leave a comment" input field. The main content area displays a "Books (126)" shelf with a search bar and a grid of book covers. The books shown include "Paths Beyond Ego", "Joseph Campbell: Pathways to Bliss", "The Empress", "Kyra" by Carol Gilligan, "The Portable Jung", "Official Guide for the NEW TOEFL", "Integral Life Practice", "Integral Spirituality", "The Unfolding Now", "Space User Inquiry", "Diamond Heart", "Brilliancy", "Lisa Jewell", "The Children's Book", and "The Girl with the Dragon Tattoo". On the right side, there are sections for "Friends more" and "Neighbors more", each listing several user names with small profile pictures.

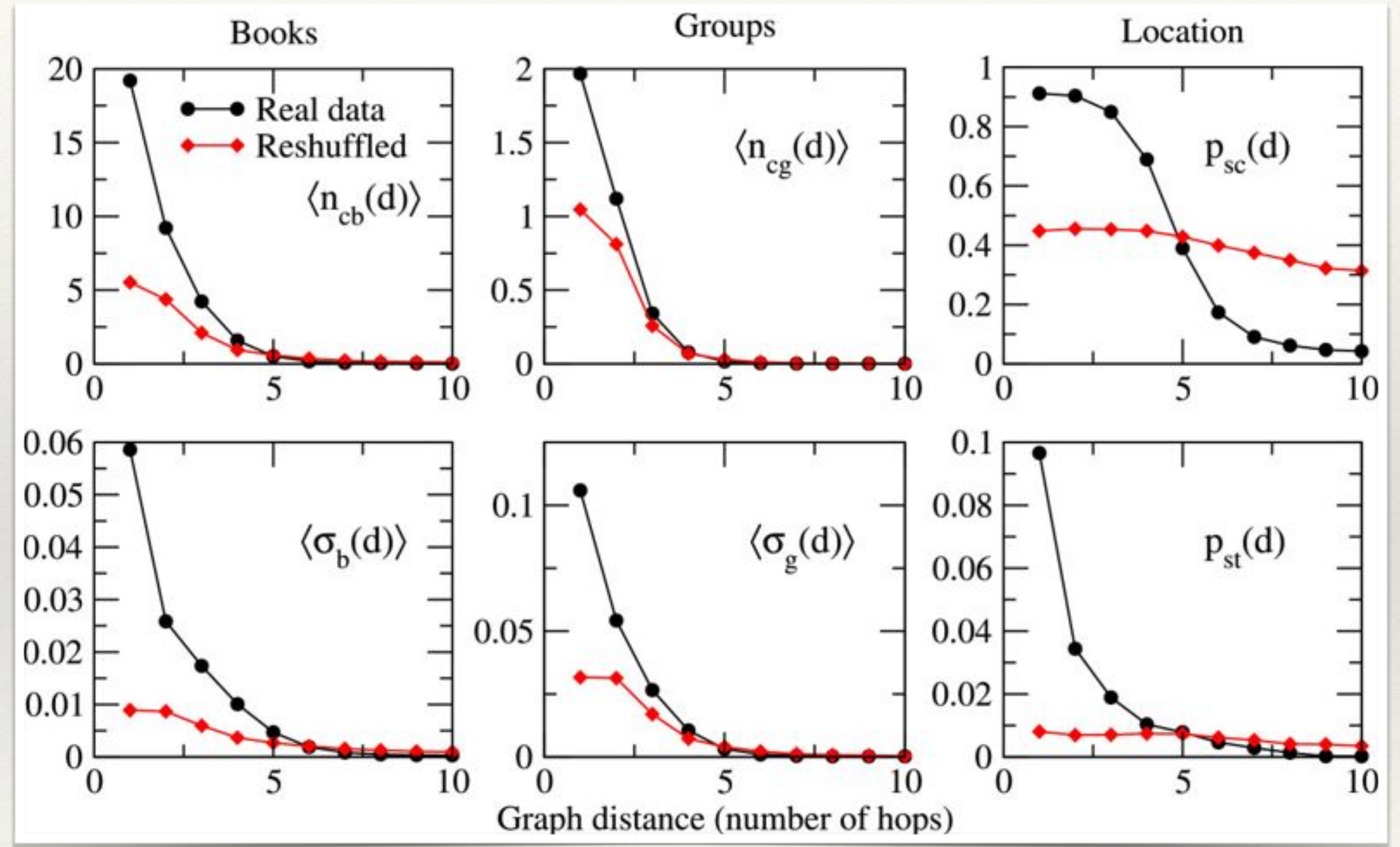
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- ❖ The bot "Lajello" used to silently navigate Anobii twice a month for one year



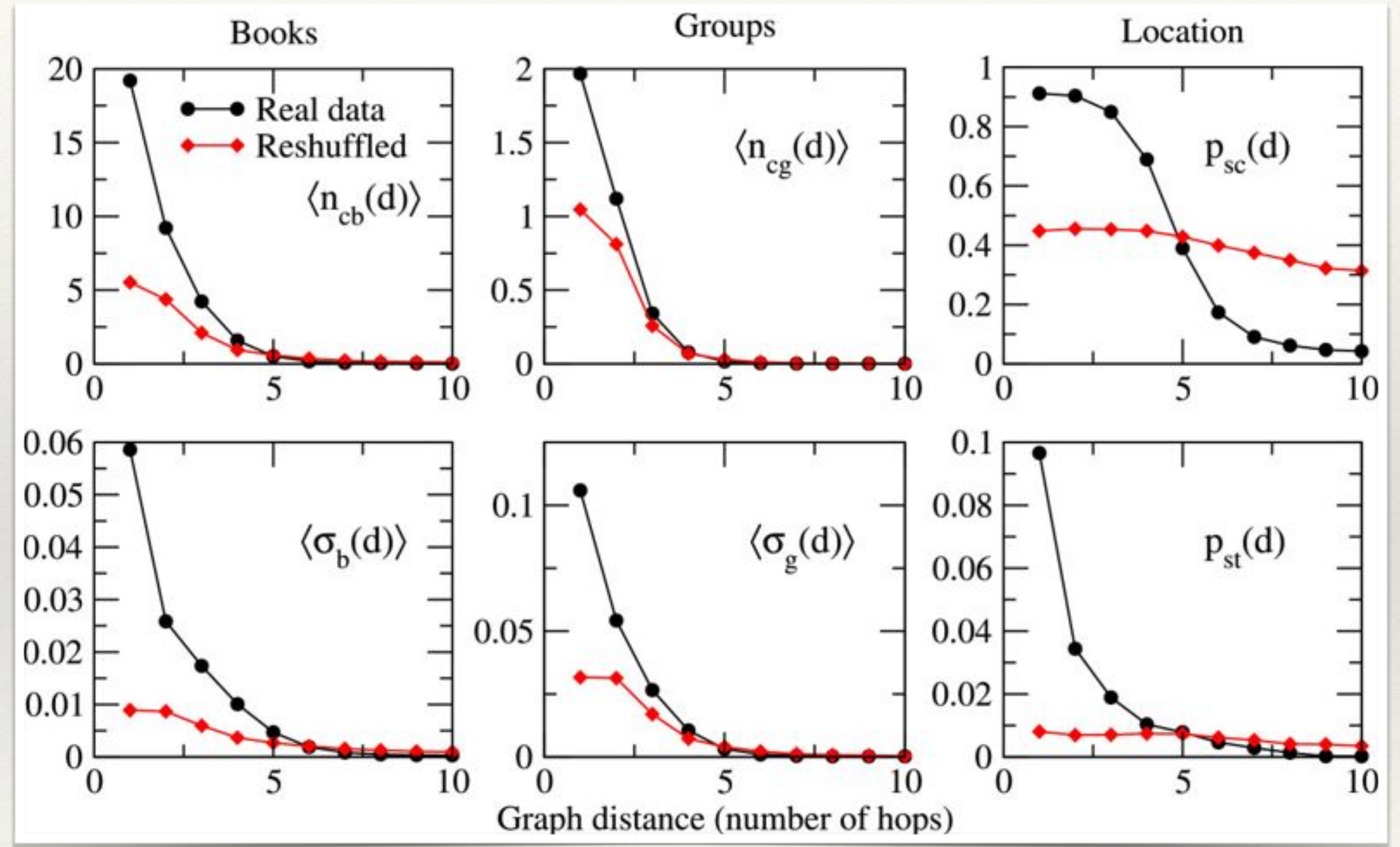
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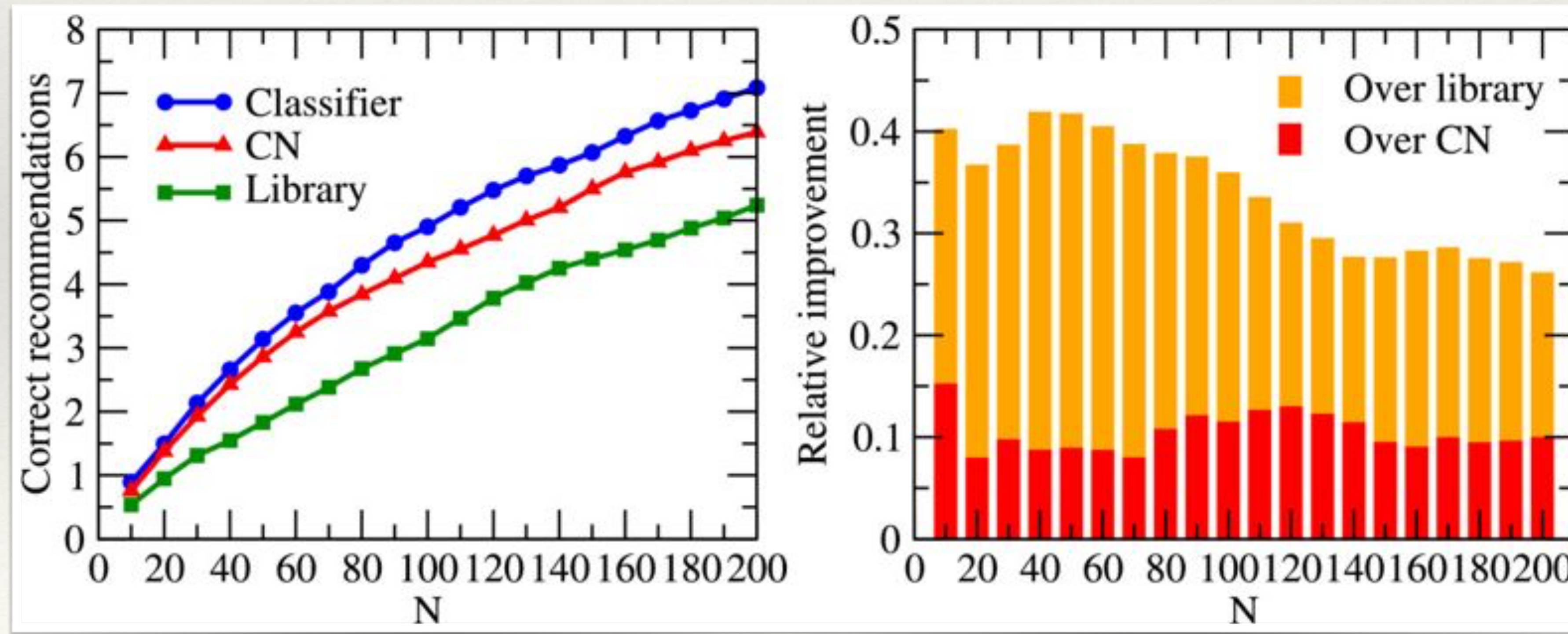


LM Aiello, A Barrat, C Cattuto, G Ruffo, R Schifanella, [Link creation and profile alignment in the aNobii social network](#), 2010 IEEE 2nd Int. Conf. on Social Computing, 249-256

LM Aiello, A Barrat, C Cattuto, G Ruffo, R Schifanella, [Link creation and information spreading over social and communication ties in interest based online social network](#), EPJ Data Science 1 (1), 12

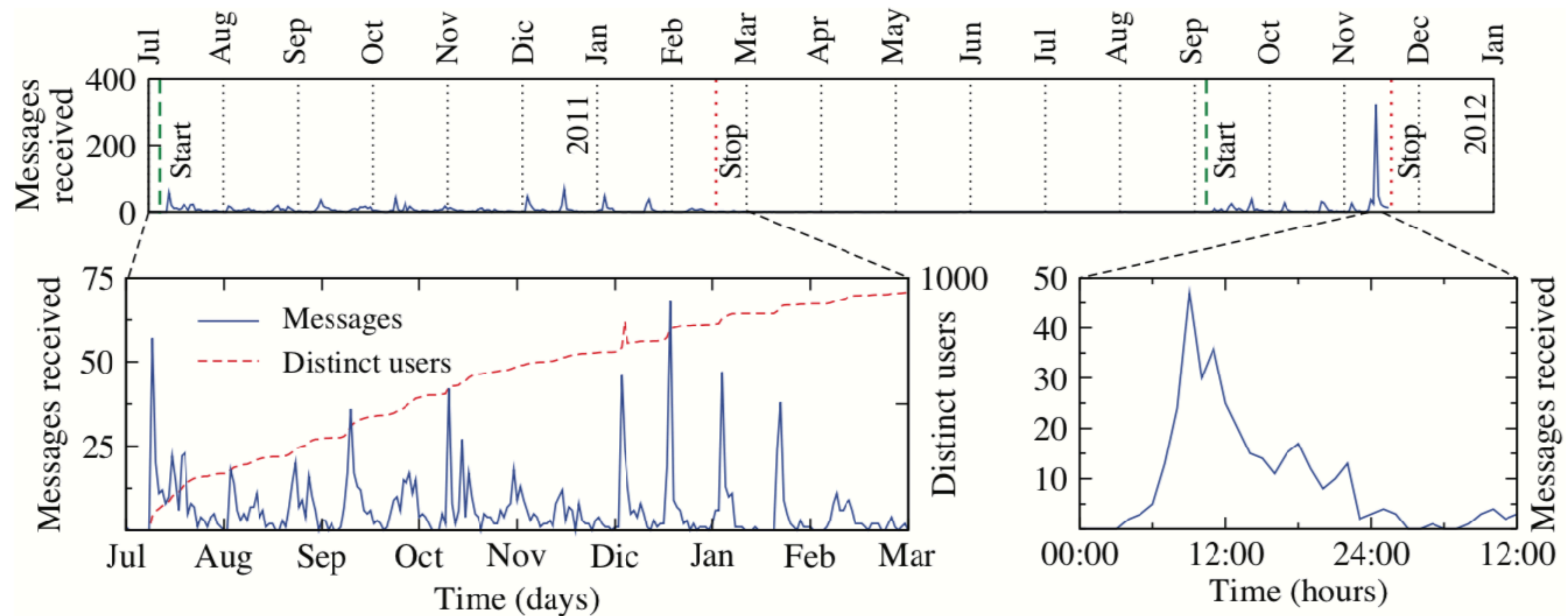
Application: a link recommendation algorithm

- ❖ A link recommendation algorithm based on prediction of profile similarities was proposed and tested
- ❖ Results showed an improvement w.r.t. the baselines



What happened to Lajello?

Lajello, incidentally, became the second most popular user in Anobii in terms of messages from distinct users



Exploiting Lajello popularity

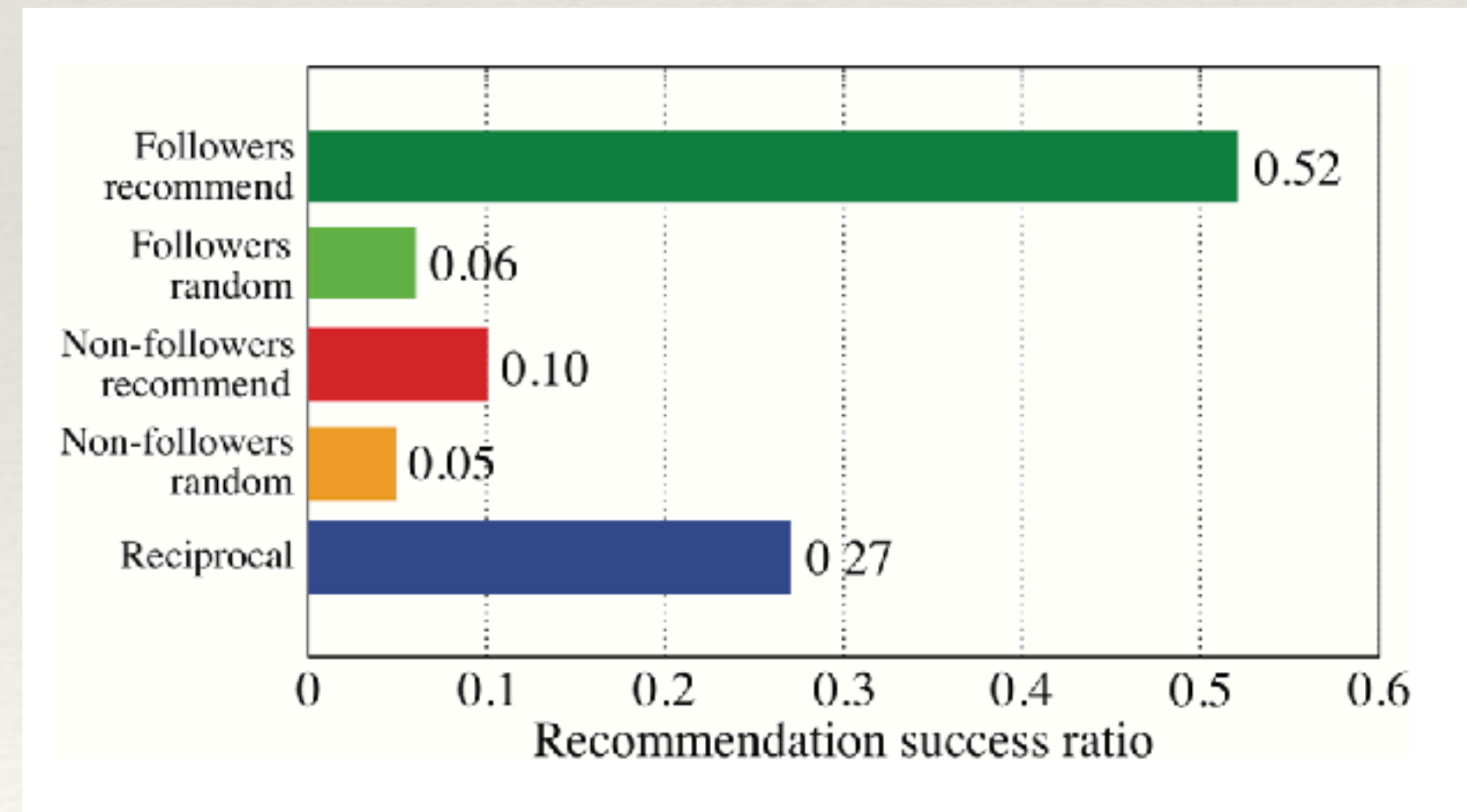
Exploiting Lajello popularity

- ❖ Lajello started to introduce users to each other according our link recommendation algorithm

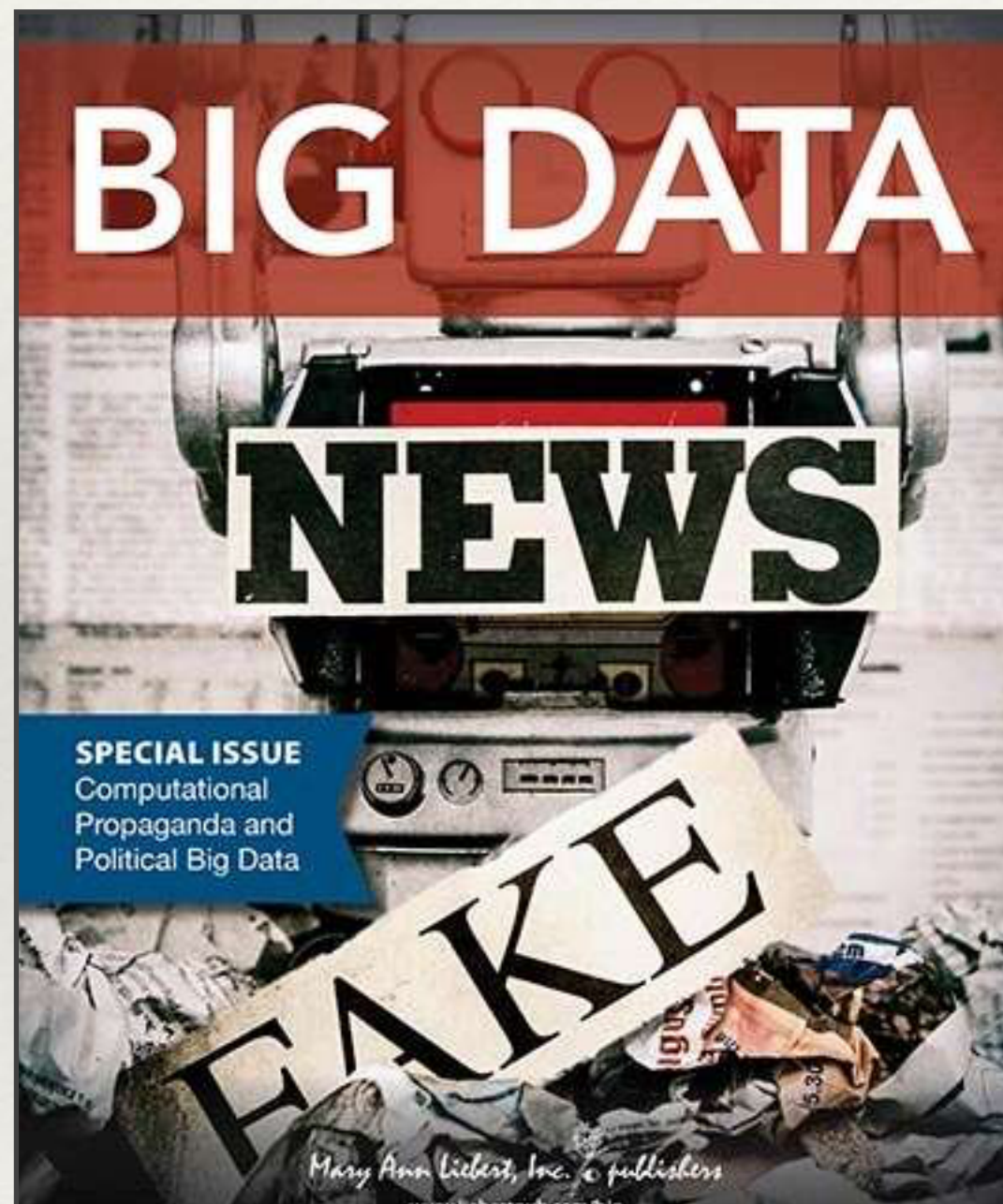


Exploiting Lajello popularity

- ❖ Lajello started to introduce users to each other according our link recommendation algorithm
- ❖ First result: users acceptance of the recommendation skyrocketed if they previously wrote in Lajello's wall



Influence of bots



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Home / Magazine Archive / July 2016 (Vol. 59, No. 7) / The Rise of Social Bots / Full Text

REVIEW ARTICLES
The Rise of Social Bots

By Emilio Ferrara, Onur Varol, Clayton Davis, Filippo Menczer, Alessandro Flammini
Communications of the ACM, Vol. 59 No. 7, Pages 96-104
10.1145/2818717
[Comments \(1\)](#)



nature
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Article | [Open Access](#) | Published: 20 November 2018

The spread of low-credibility content by social bots

Chengcheng Shao, Giovanni Luca Ciampaglia, Onur Varol, Kai-Cheng Yang, Alessandro Flammini & Filippo Menczer

Nature Communications **9**, Article number: 4787 (2018) | [Download Citation](#) ↓

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- Two polarized opinions emerged: Anobii users created immediately two thematic groups: “the (not requested) suggestions of Lajello” and “Hands-off Lajello”
- A large portion of users that were contacted by Lajello joined to one of these groups

Incidentally, we created an “egg war”

- After our initial experiment, Lajello remained silent for one year and then he “talked”. The recommendations changed the net structure and Lajello account was banned after 24 hours. This ignited a “war”
- Two polarized opinions emerged: Anobii users created immediately two thematic groups: “the (not requested) suggestions of Lajello” and “Hands-off Lajello”
- A large portion of users that were contacted by Lajello joined to one of these groups
- We observed a strong interplay between the existing relationships in the social network and the opinion that emerged from the users at the end of the links: “**echo chamber**” effect?

Social polarization and emotional reaction

Social polarization and emotional reaction

 red dots are lajello **supporters**

Social polarization and emotional reaction

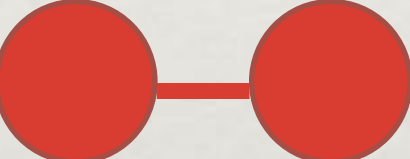
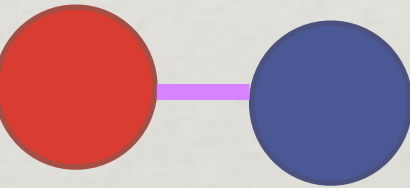
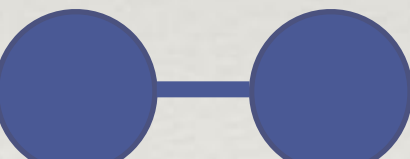
 red dots are lajello **supporters**

 blu dots are lajello **haters**

Social polarization and emotional reaction

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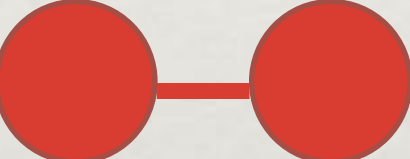
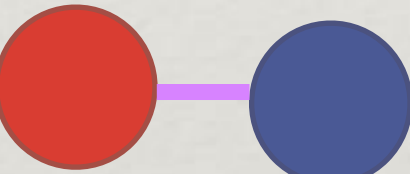
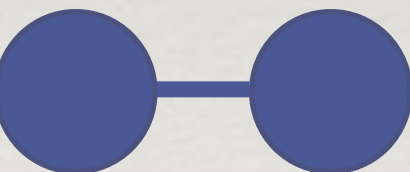
 blu dots are lajello **haters**

 links are existing
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 or **direct messages**
(graph is directed)


Social polarization and emotional reaction

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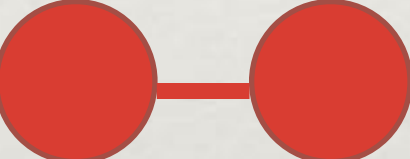
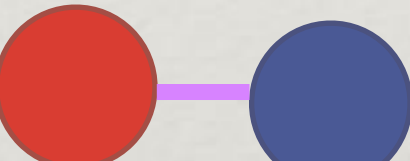
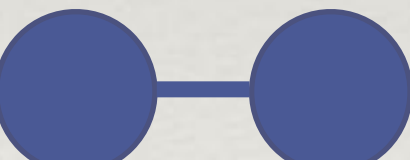
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 (graph is directed)

 bigger dots are
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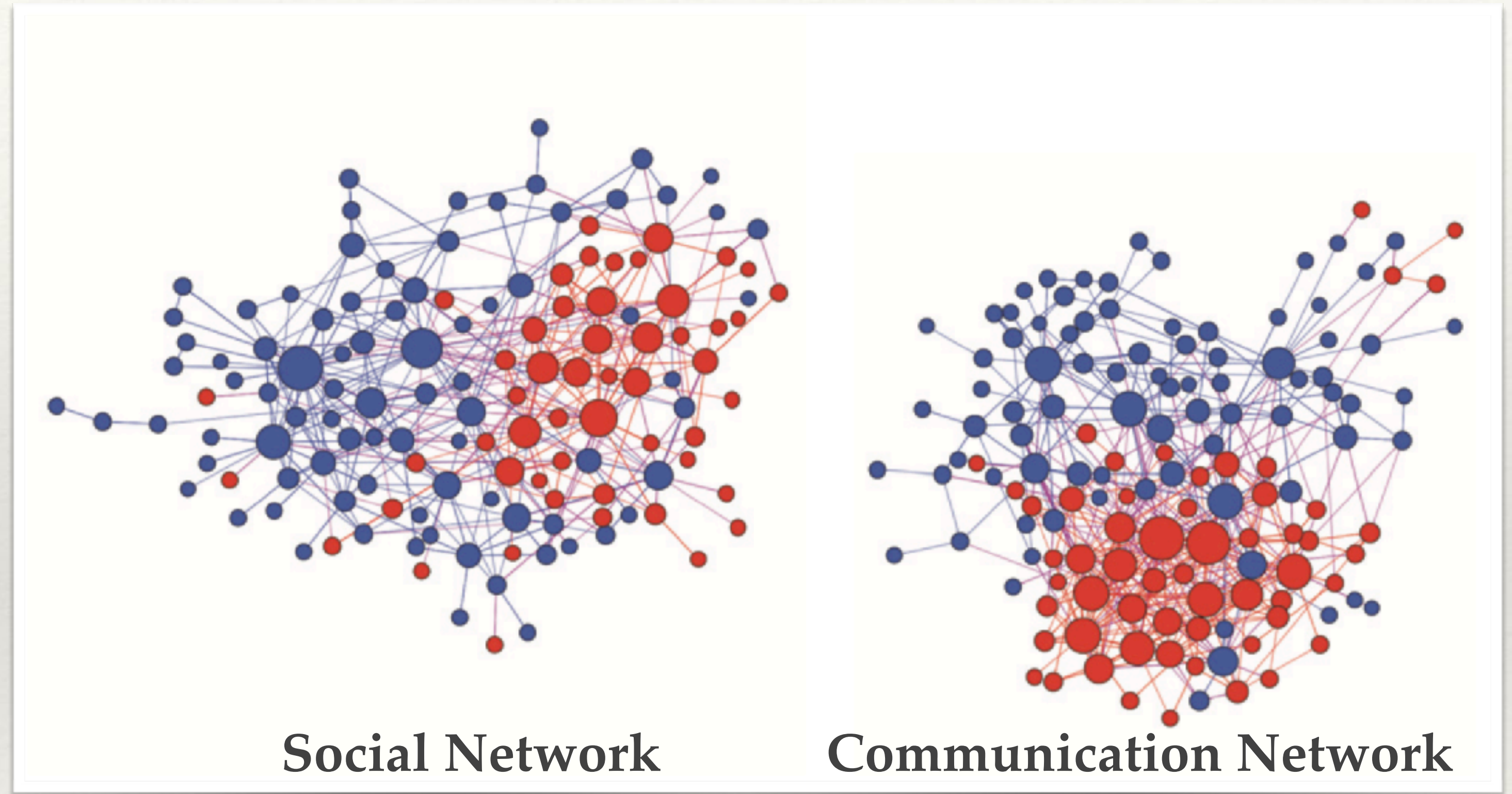
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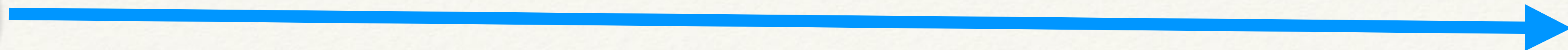
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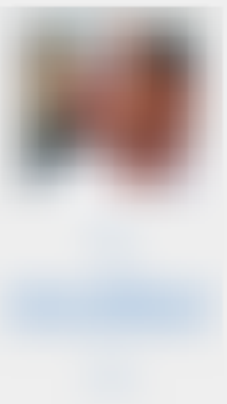

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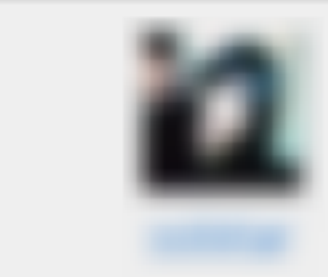

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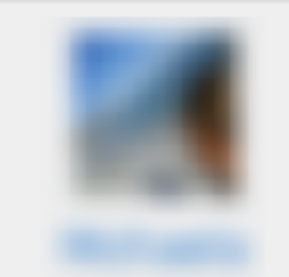

Automatic network-based [community detection](#) algorithm (OSLOM) accurately finds clusters (80% - Social network, 72% - Communication network), confirming a signal of **segregation** between the two groups before link recommendations

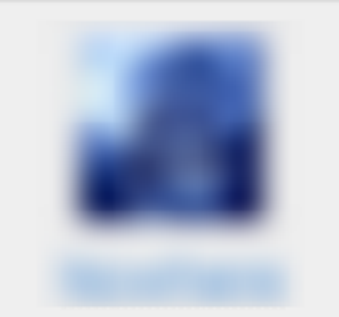



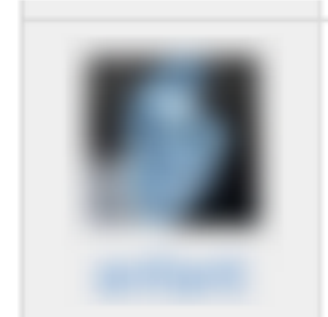
 LAJELLO... HAI STUFATO..NON SE NE PUO' PIU'...STA ATTENTO/A CHE SONO CAPACE DI ASSOLDARE UN HACKER PER VEDERE CHI SEI..E PO' SONO C...TUOI
Tre settimane fa 

 ahahahhahahaha tu sei un genio!!!! sei davvero un genio!!! insomma ma quante visualizzazioni hai???? sei un grande!!!! riesci a farti visitare e a farti scrivere pur non avendo libri!!! ti adoro sei grandissimo :P
Aug 13, 2010 

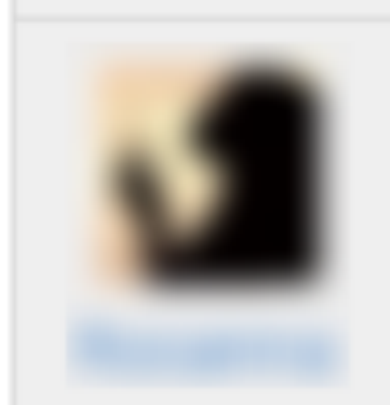
 chi sei?

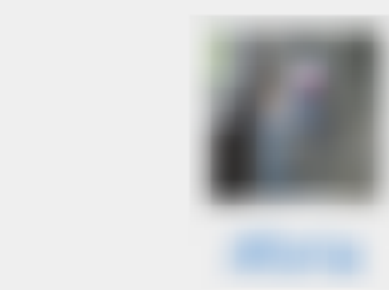

 un grande.
continua così. Grazie delle visite, si vede che ti sto simpatica...
P.S: propongo di aprire un gruppo the Lajellos fans...
3 giorni fa 

 già che mi ritrovo qui mi faccio pubblicità! Venite a vedere la mia libreria è la più bella -del mondo-. (l'ultima parte andava sottolineata..)
Due set 

 chapeau!!

 Le tue visite cominciano ad essere inquietanti....

 ahahahaahah tu sei un genio!!

 Grazie Lajello, mi sono divertita un sacco a leggere i commenti degli altri anobiani. Sembra un esperimento di psicologia sociale, se non ti dispiace ti aggiungo come vicino! e resisti eh...non pubblicare un libro! ;)
Due settimane fa 

Lessons learned and observations

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- ❖ Handle experiments in social media with care :)



il POST ITALIA MONDO POLITICA TECNOLOGIA INTERNET SCIENZA CULTURA ECONOMIA SPORT MEDIA MODA LIBRI AUTO VIDEO

CARLO BLENGINO **BLOG** VENERDÌ 27 LUGLIO 2012

Lo strano caso Lajello

f Lajello compare in rete in una fredda mattina di fine 2009, su aNobii, il social network dedicato ai libri ed alla lettura.

t Tutto inizia al Dipartimento di Informatica dell'Università di Torino dove un gruppo di ricercatori dell'**ARCS (Applied Research on Computational Complex System)** studia i complicati link e le dinamiche che si formano nei social media e sul web. Fanno data mining sulle enormi quantità di informazioni che quotidianamente immettiamo in rete, sui social network.

Nel loro lavoro il "dimmi con chi vai e ti dirò chi sei" può declinarsi al futuro: dimmi con chi vai e ti dirò non solo chi sei, ma chi sarai domani, chi conoscerai, dove andrai nelle prossime ore, cosa comprenderai e chi voterai.

 **Carlo Blengino**
Avvocato penalista, affronta nelle aule giudiziarie il diritto delle nuove tecnologie, le questioni di copyright e di data protection. È fellow del NEXA Center for Internet & Society del Politecnico di Torino. @CBlengio su Twitter

Lessons learned and observations

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- ❖ A simple spambot can take power in a social network

The image shows a screenshot of a news article from the Italian newspaper 'il POST'. The article is titled 'Lo strano caso Lajello' and is dated 'VENERDÌ 27 LUGLIO 2012'. The author is 'CARLO BLENGINO'. The article is categorized under 'BLOG'. The main headline of the article is 'How a Simple Spambot Became the Second Most Powerful Member of an Italian Social Network'. The sub-headline is 'Connectivity'. The article text begins with 'The surprising story of how an experiment to automate the creation of popularity and influence became successful beyond all expectation.' The article is attributed to 'Emerging Technology from the arXiv' and dated 'Aug 5, 2014'. On the right side of the article, there is a profile for 'Carlo Blengino', an attorney who specializes in technology law, copyright, and data protection. He is a fellow of the NEXA Center for Internet & Society at the Politecnico di Torino. His Twitter handle is @CBlengio.

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MIT Technology Review

Connectivity

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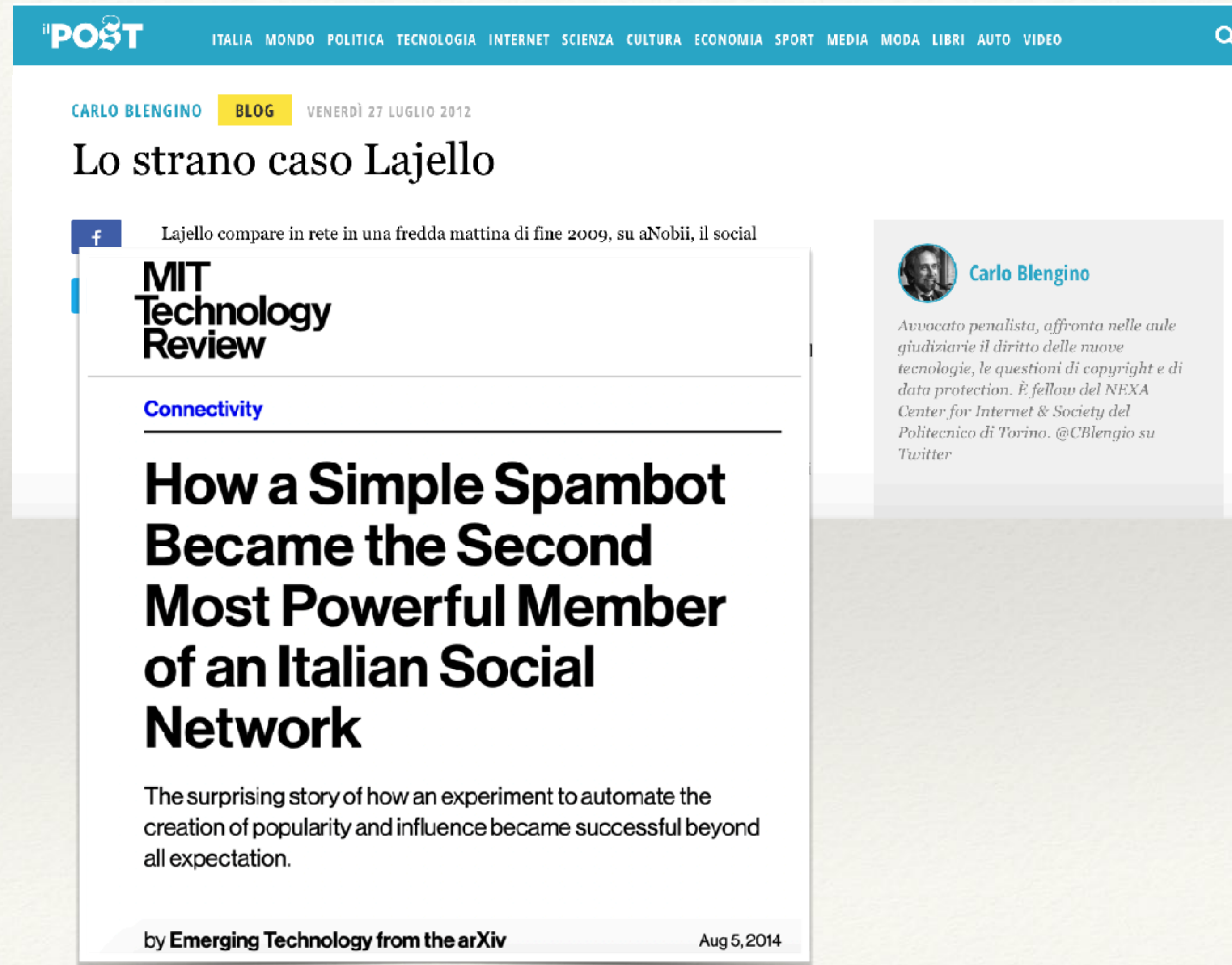
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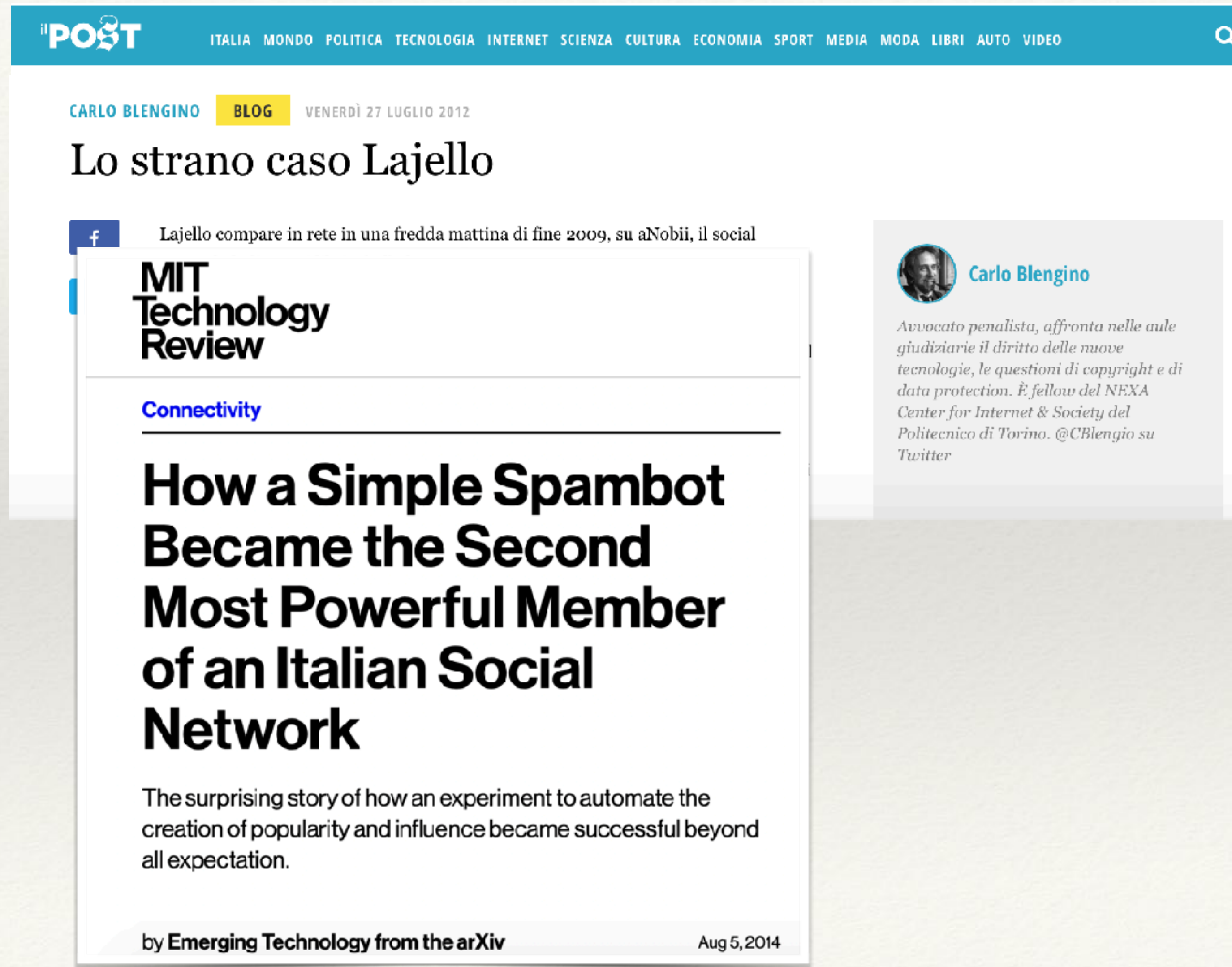
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- ❖ ... also the structure changed after our experiment was run!
- ❖ What if the real identity and motivations of Lajello were fact-checked?



il POST ITALIA MONDO POLITICA TECNOLOGIA INTERNET SCIENZA CULTURA ECONOMIA SPORT MEDIA MODA LIBRI AUTO VIDEO

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Modeling the spread of misinformation



Questions

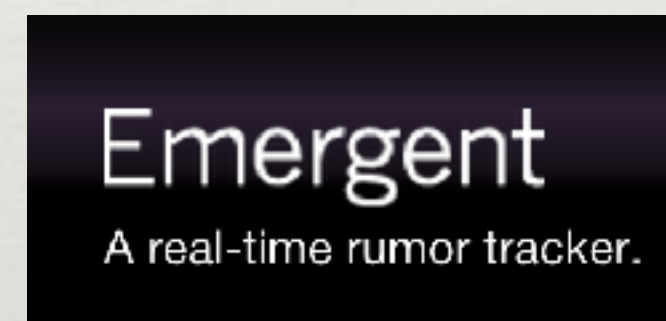


Il Disinformatico

Un blog di Paolo Attivissimo, giornalista informatico e cacciatore di bufale

Questions

- ❖ Is fact-checking effective against the diffusion of fake-news?

The logo for FactCheck.org, featuring a small American flag icon to the left of the text "FACTCHECK.ORG" in blue and red.The logo for PolitiFact, featuring a blue checkmark icon to the left of the text "POLITIFACT" in blue and red.The logo for Snopes.com, featuring a black arrow pointing to the right, with the text "Snopes.com" in black and "Rumor Has It" in smaller black text below it.The logo for Emergent, featuring the word "Emergent" in white on a black background, with the tagline "A real-time rumor tracker." below it.The logo for BUTAC, featuring a blue circular icon with a white bull's head and the text "BUTAC" in blue.The logo for Il Disinformatico, featuring the text "Il Disinformatico" in red.

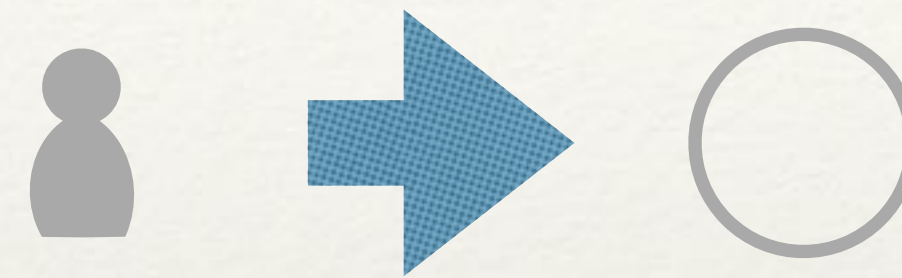
Un blog di Paolo Attivissimo, giornalista informatico e cacciatore di bufale

- ❖ Do “echo-chambers” play a role as inhibitors or facilitators of fake-news spreading?

Networks and their context

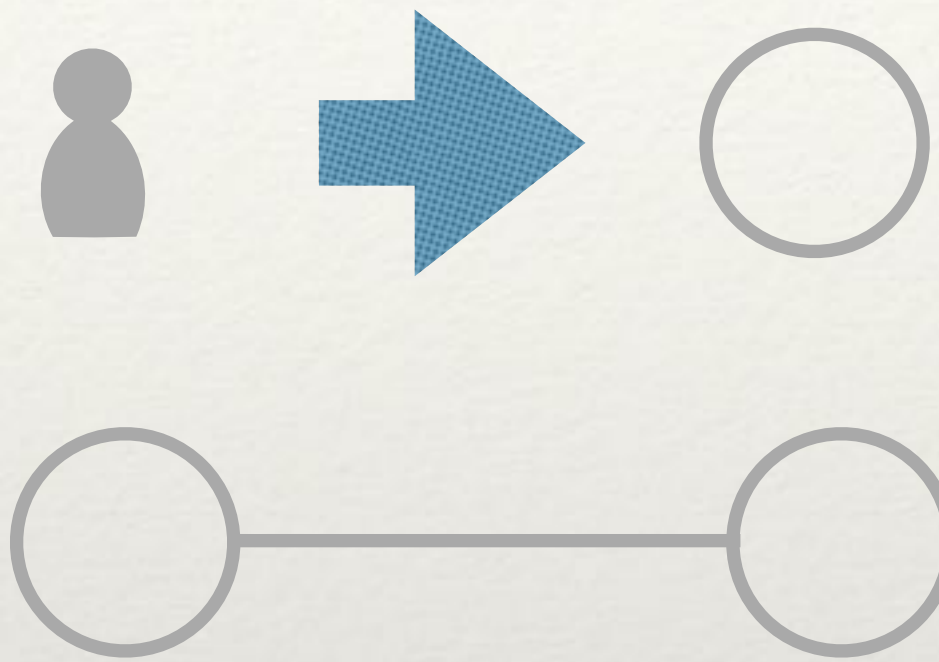
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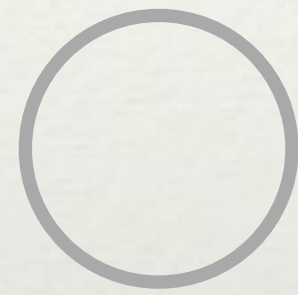


- ❖ **network topologies** can be created artificially or built from real data
- ❖ The **news is factually false** (can be debunked or someone else has already debunked it)
- ❖ We need a **model** for predictions and what-if analysis; data for validation and tuning only

Node states in the SBFC model

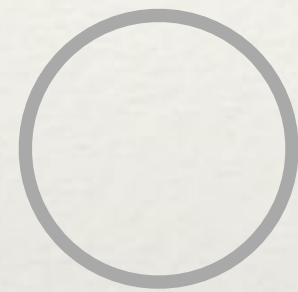
Node states in the SBFC model

❖ Susceptible

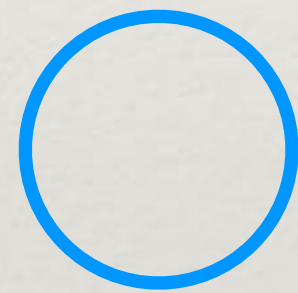


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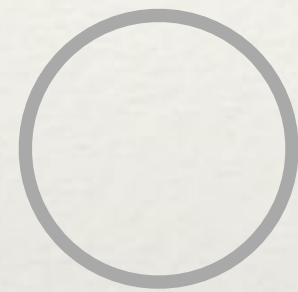


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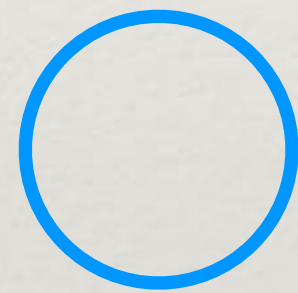


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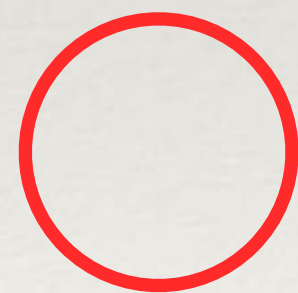
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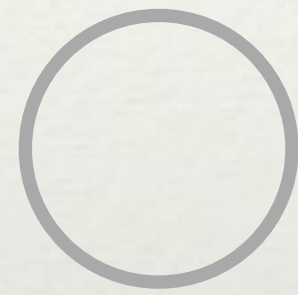


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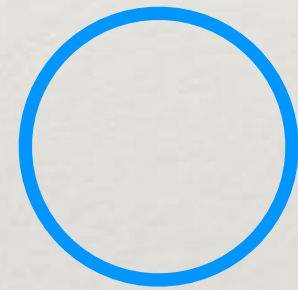


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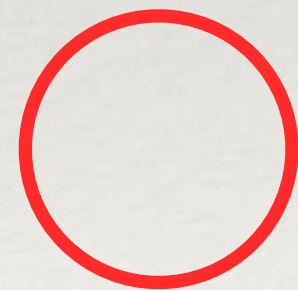
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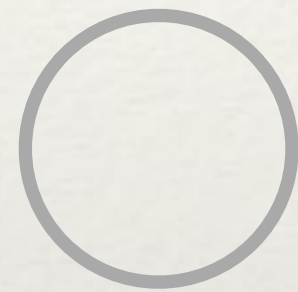


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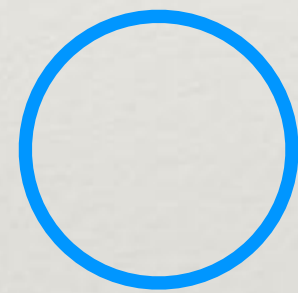


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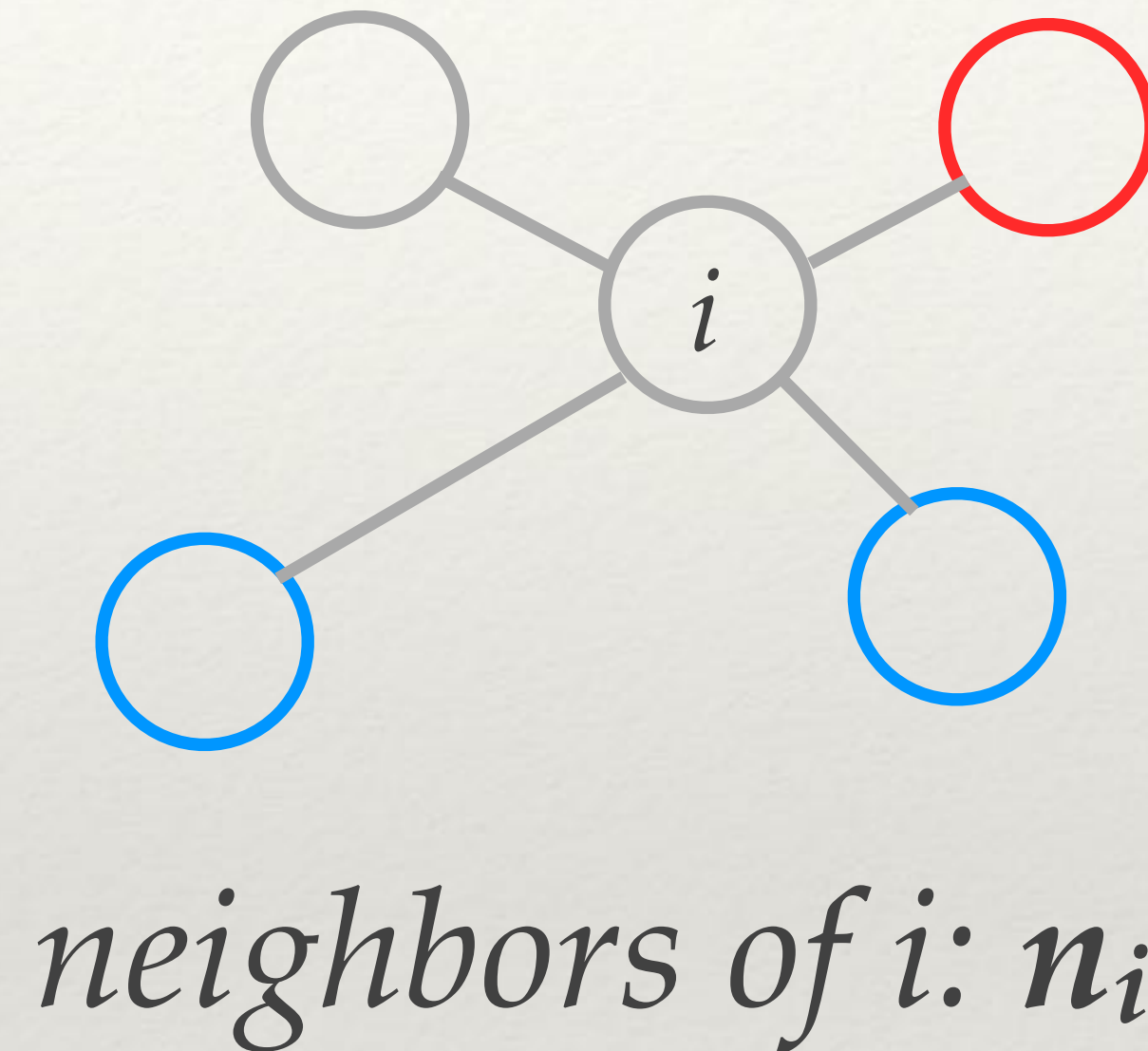
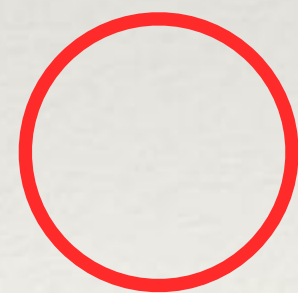
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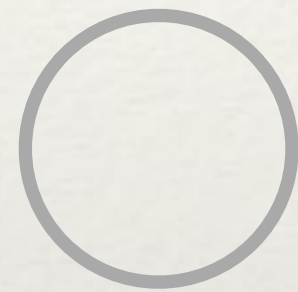


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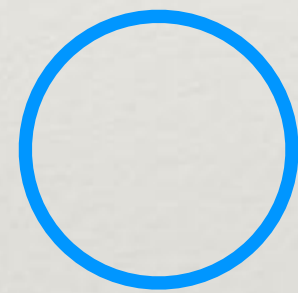


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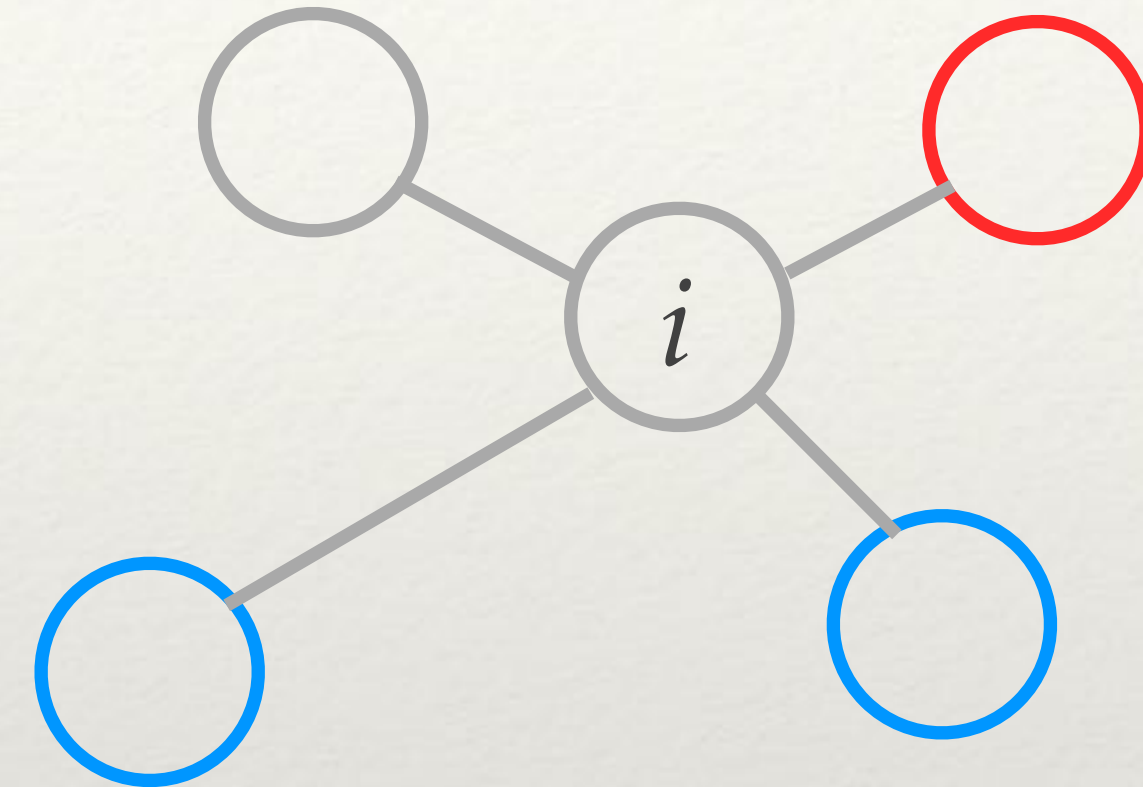
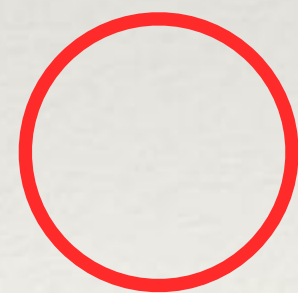
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neighbors of i : n_i

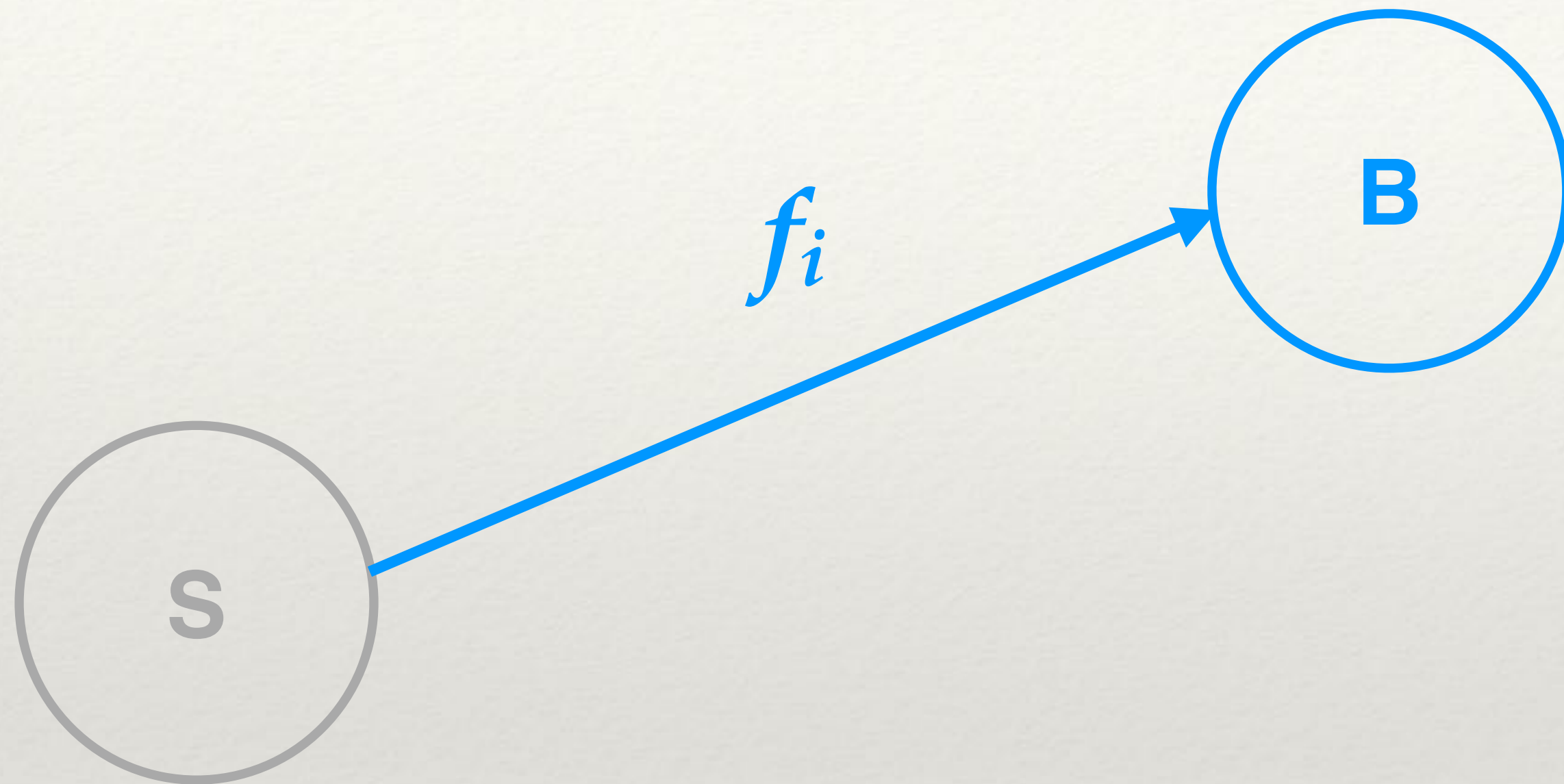
credibility of the hoax: α

spreading rate: β

From Susceptible to Believer/Fact-Checker

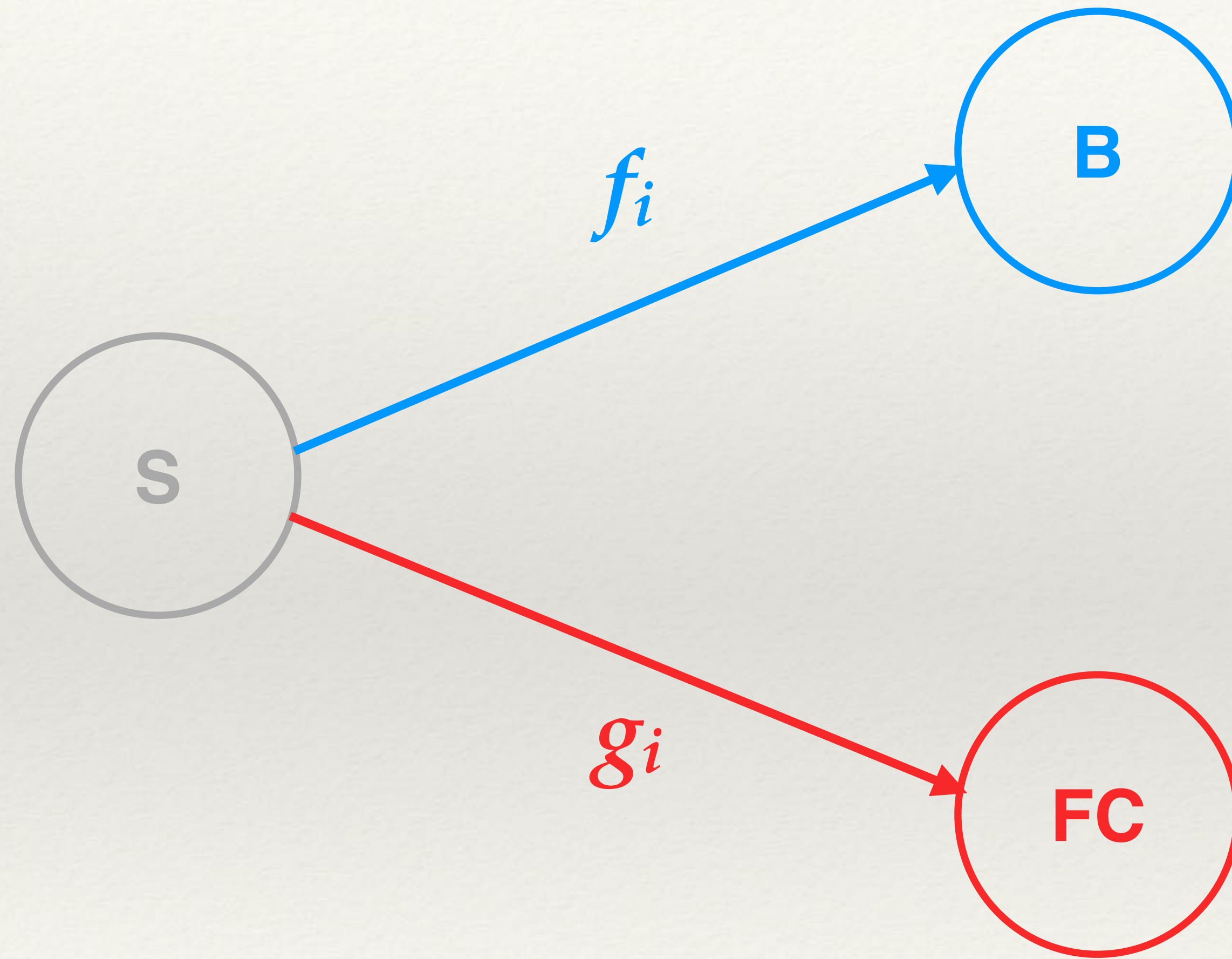


From Susceptible to Believer/Fact-Checker



$$f_i(t) = \beta \frac{n_i^B(t)(1 + \alpha)}{n_i^B(t)(1 + \alpha) + n_i^F(t)(1 - \alpha)}$$

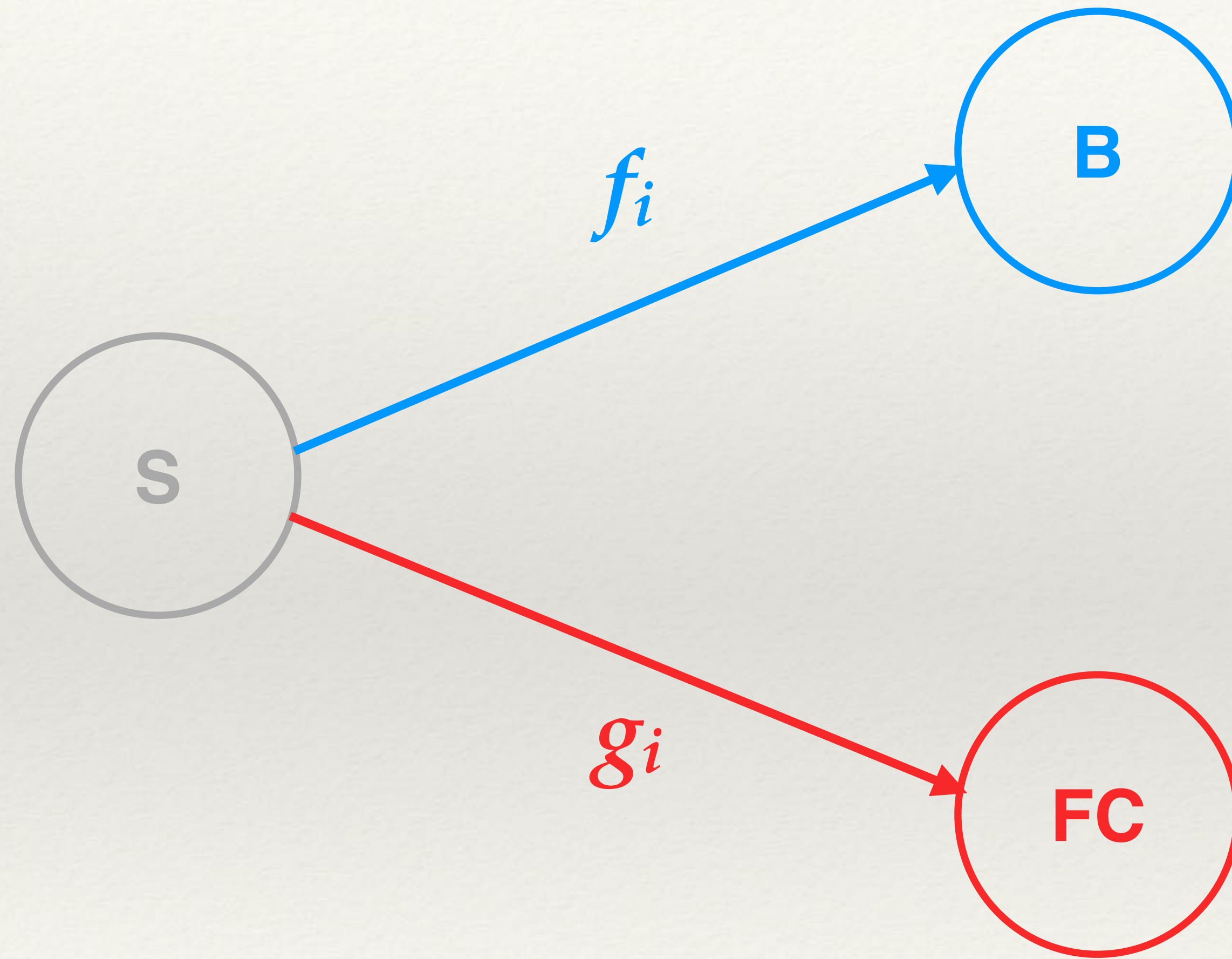
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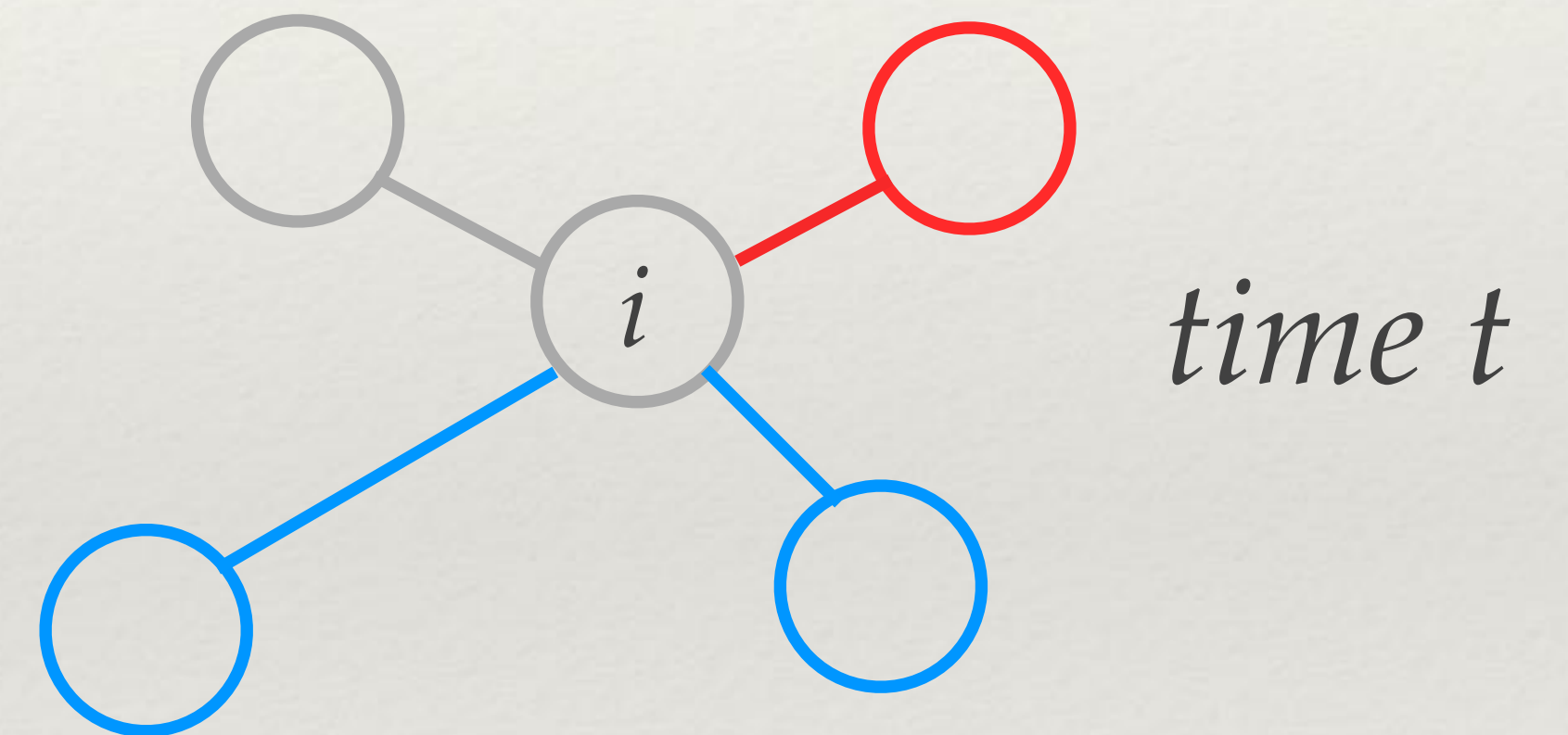
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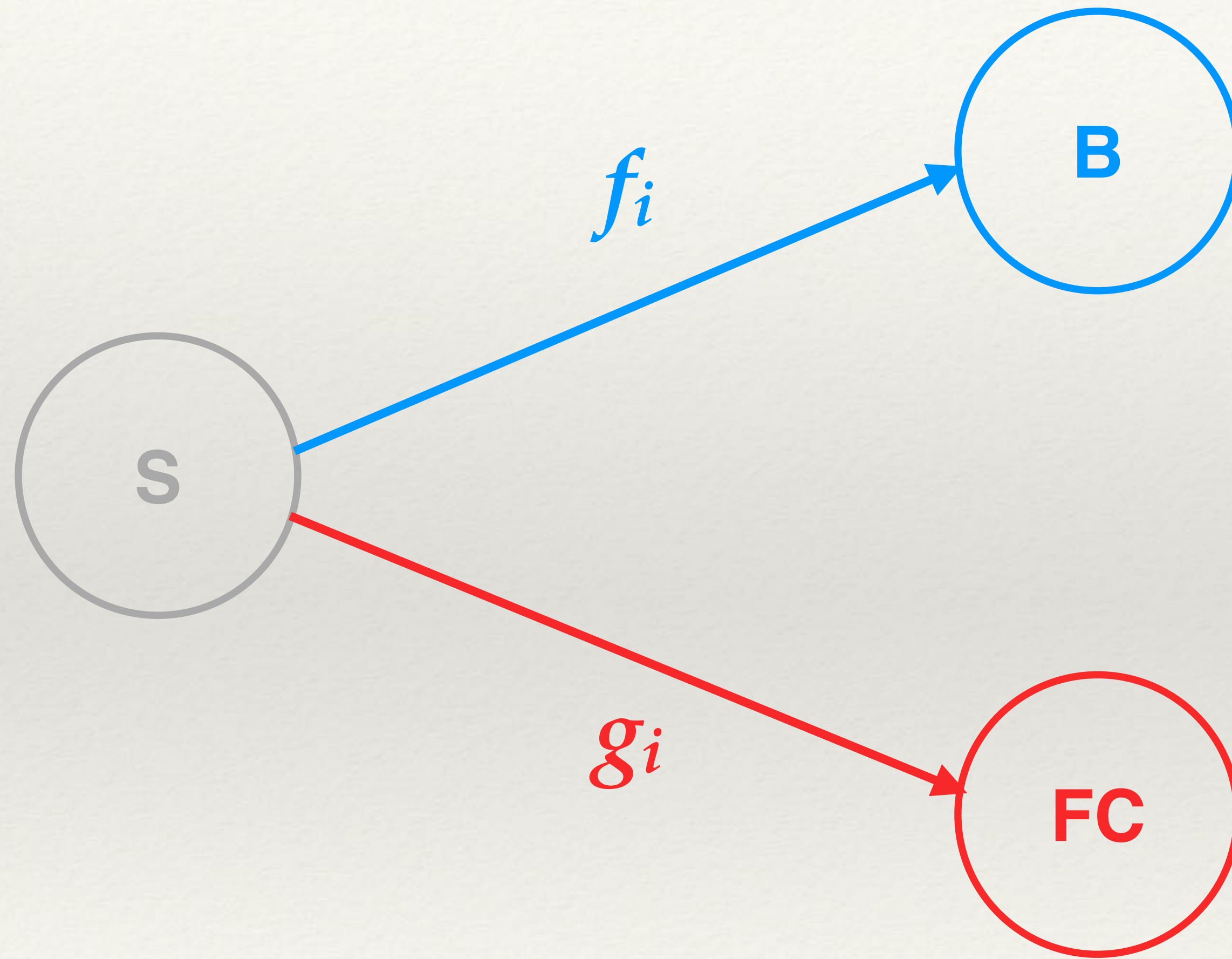


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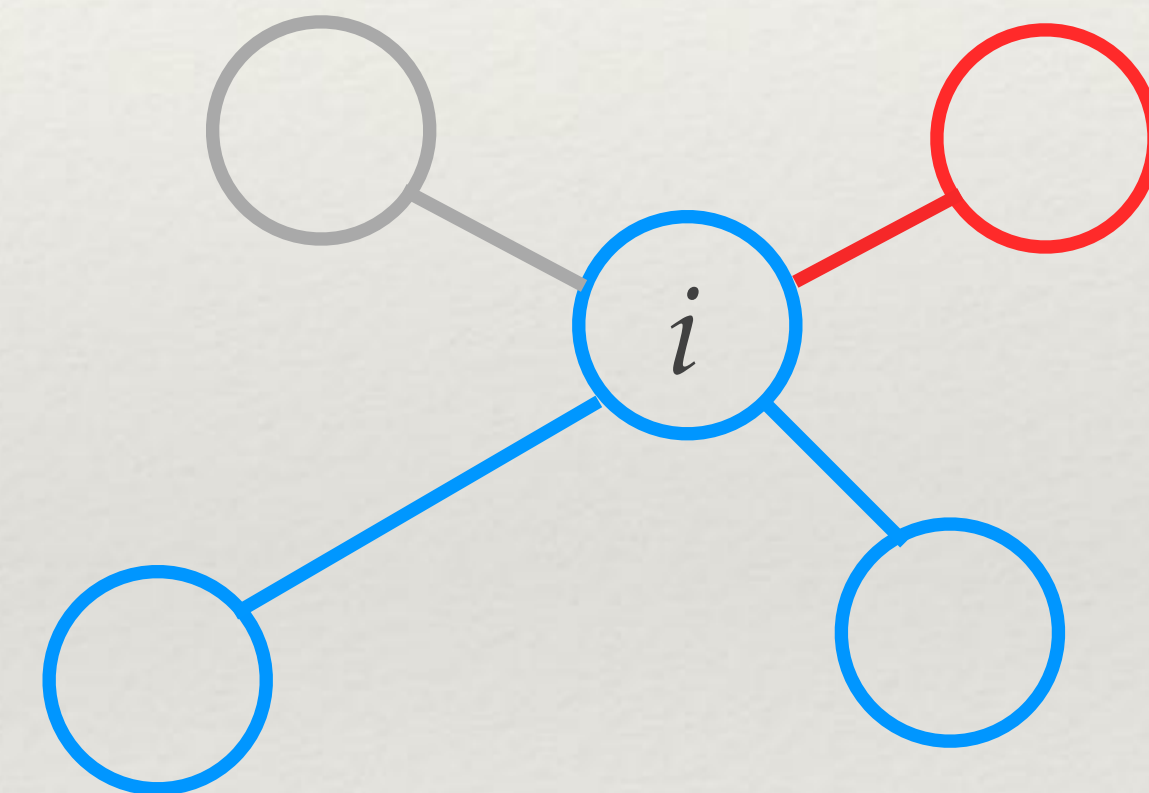


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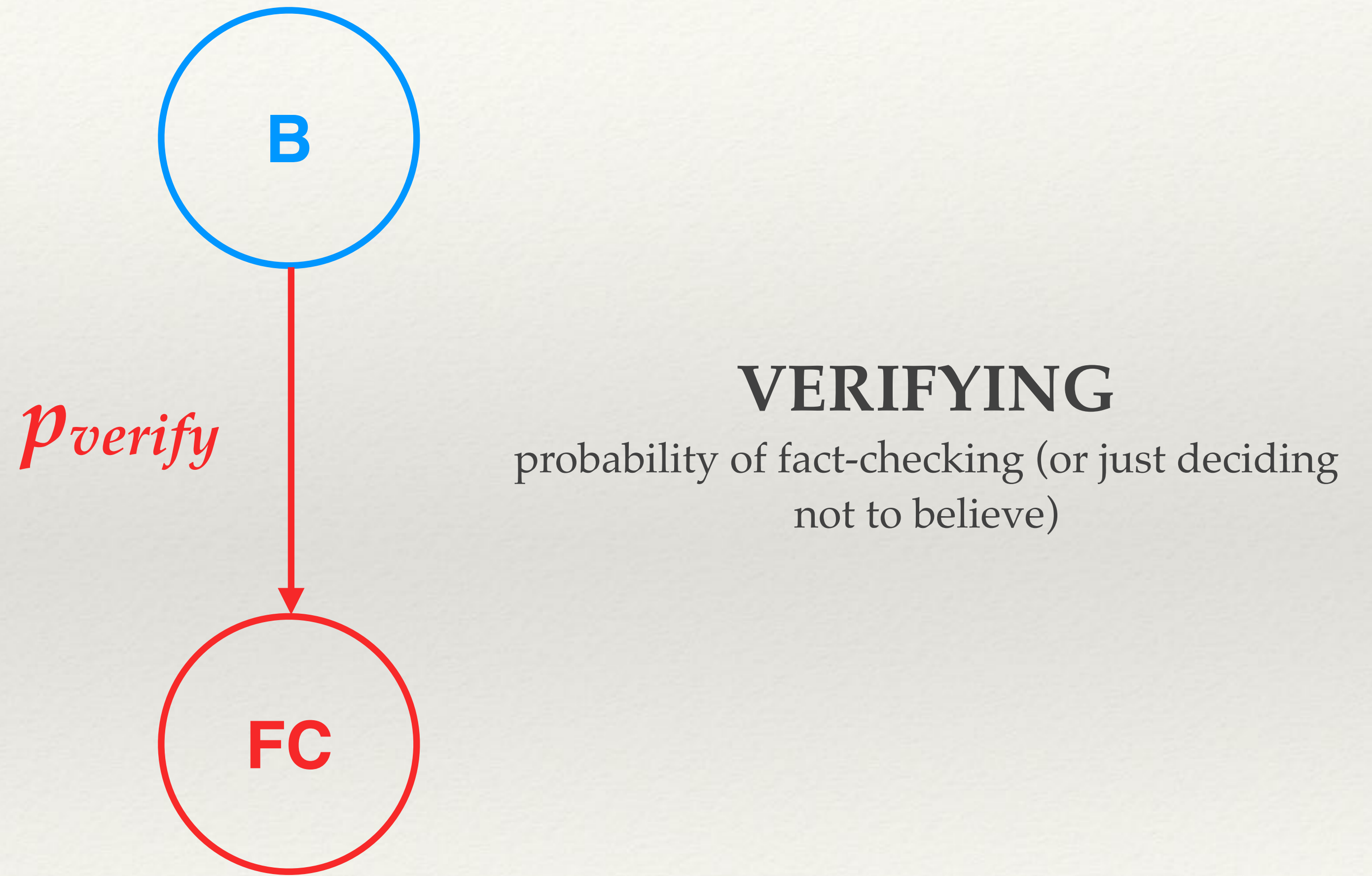
time t+1

$$g_i(t) = \beta \frac{n_i^F(t)(1 - \alpha)}{n_i^B(t)(1 + \alpha) + n_i^F(t)(1 - \alpha)}$$

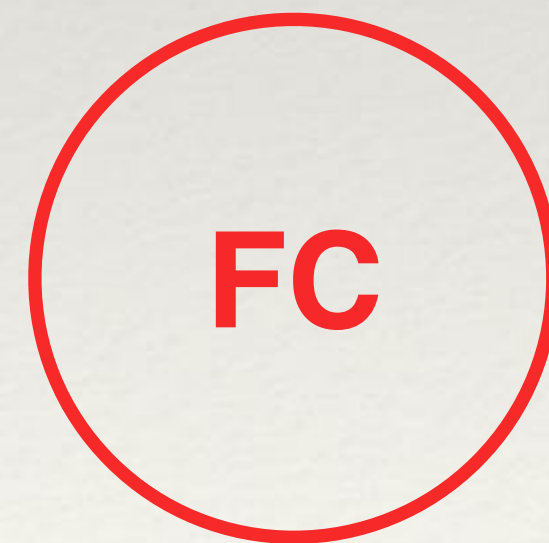
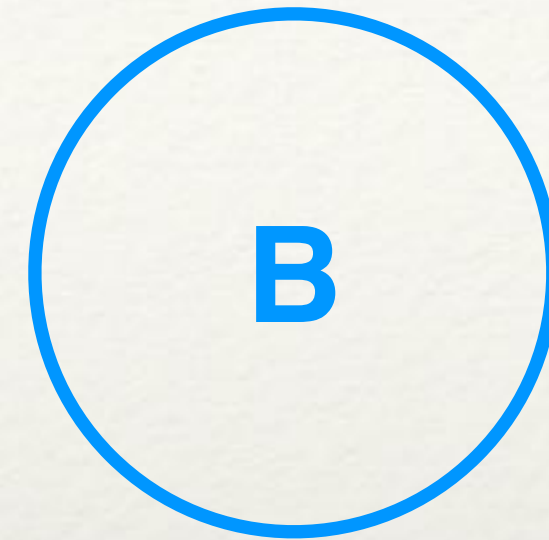
From Believer to Fact-Checker



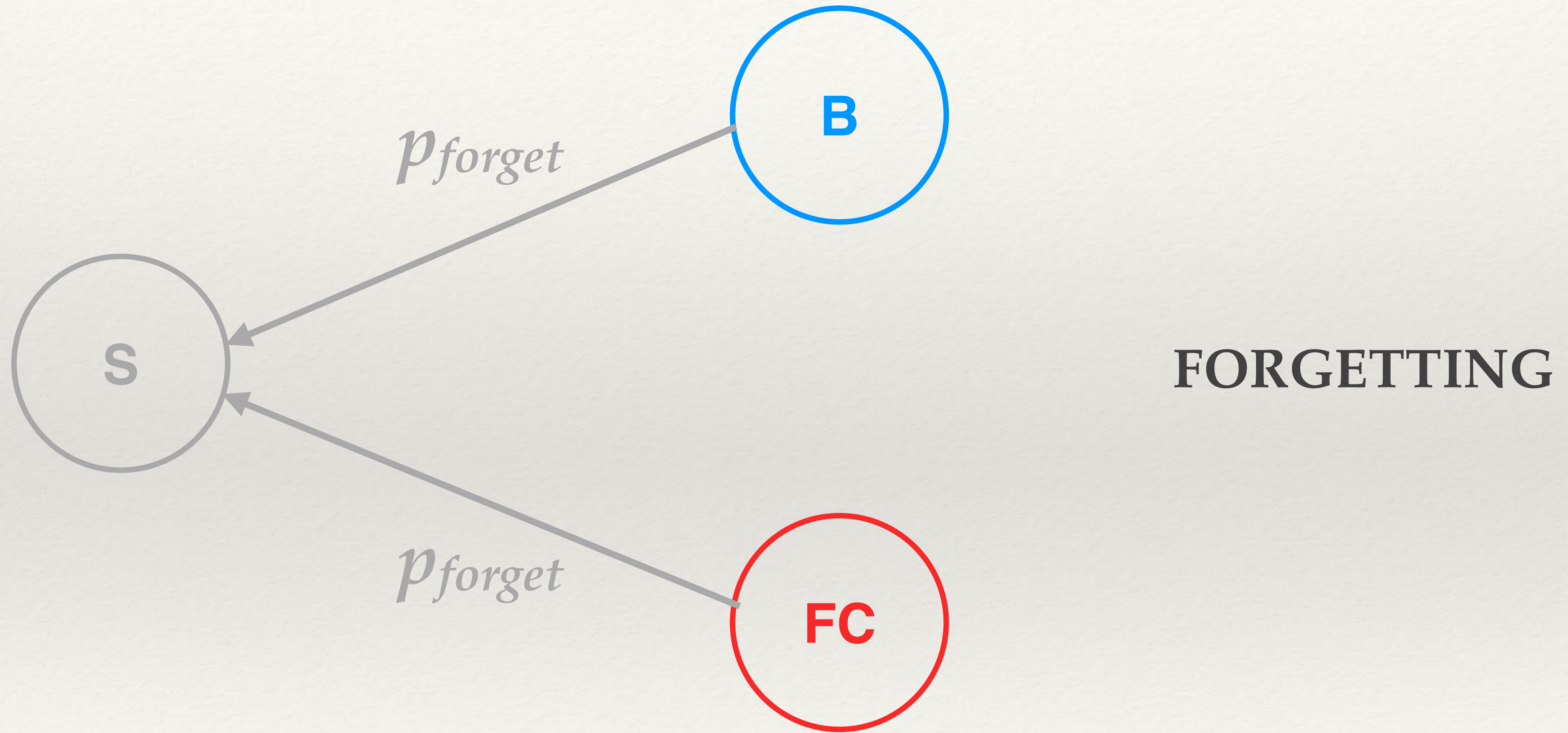
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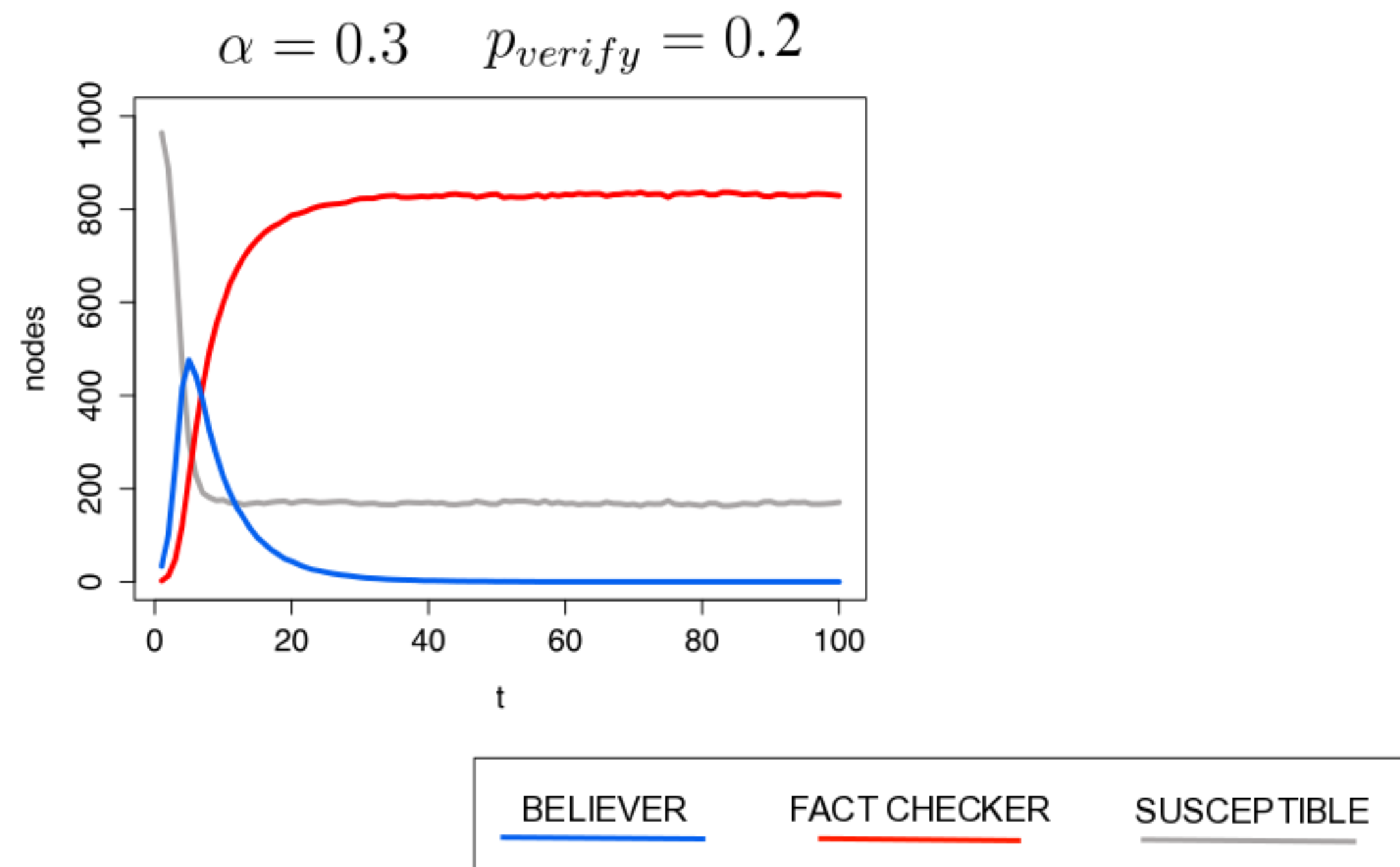
From Believer/Fact-Checker to Susceptible



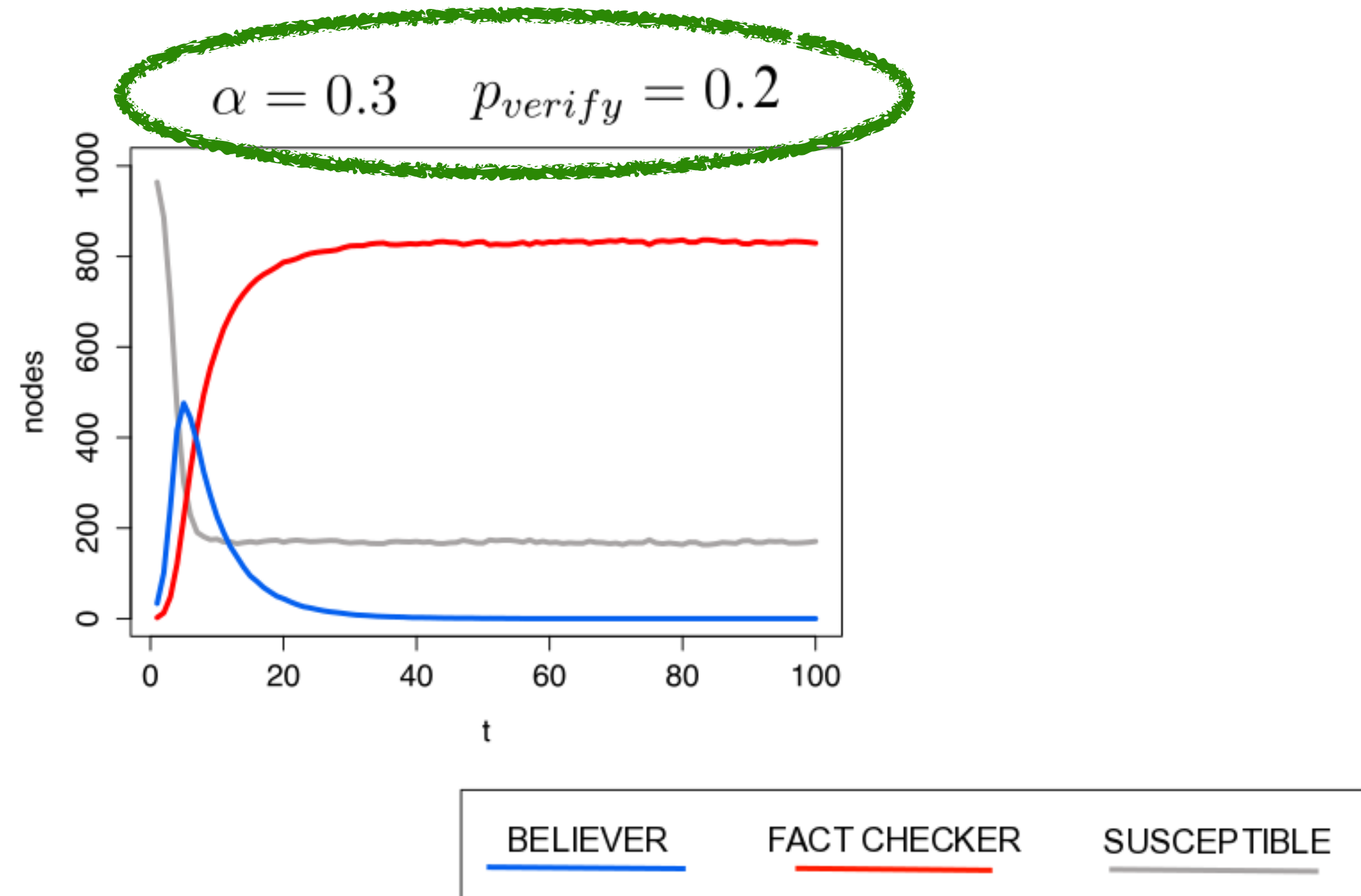
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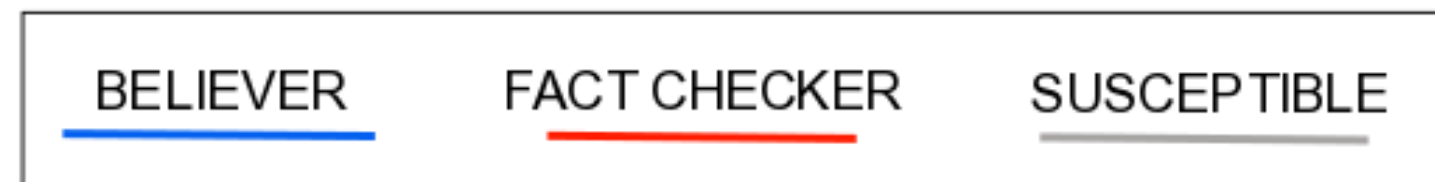
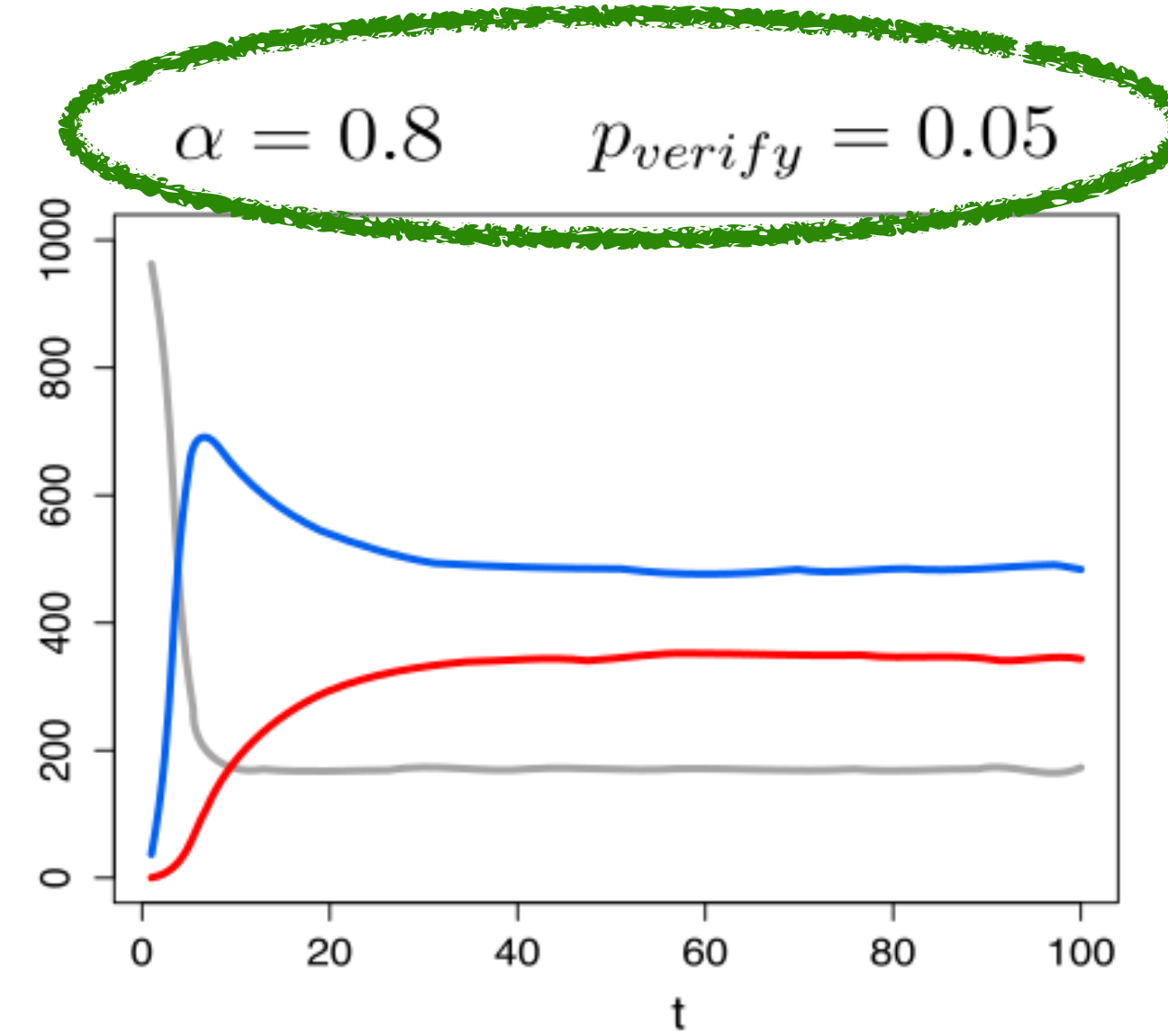
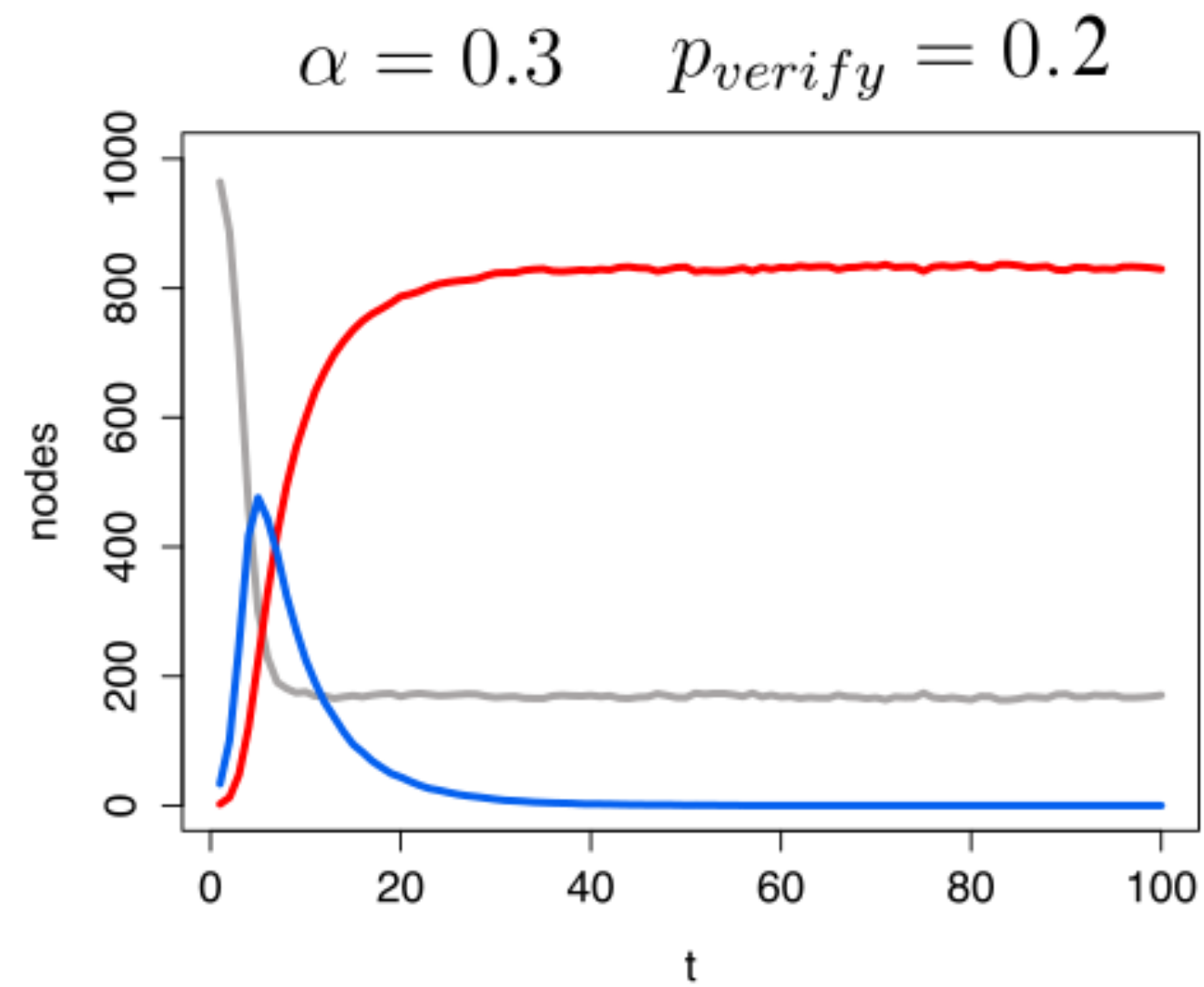
Dynamics (agent-based simulations)



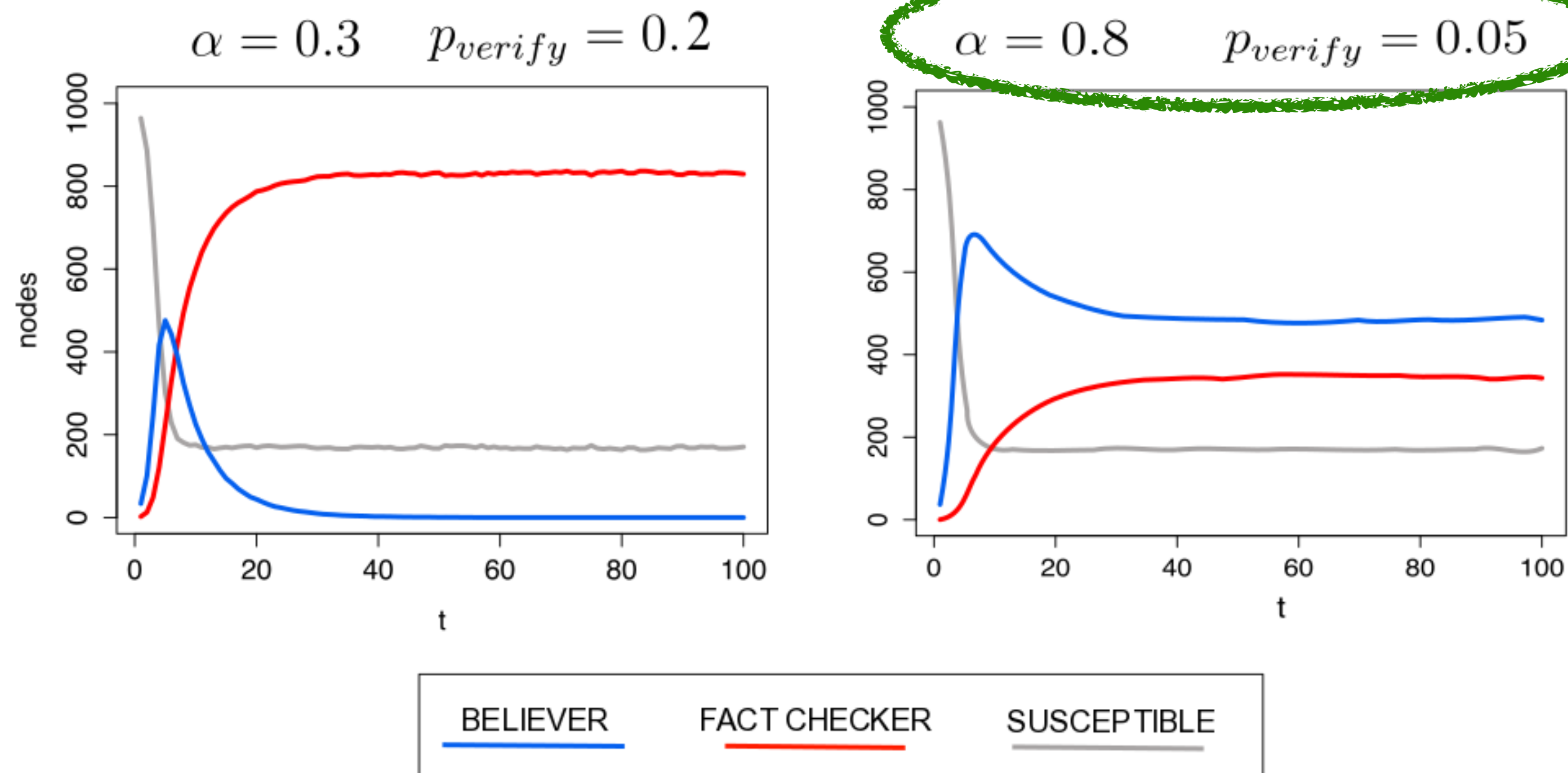
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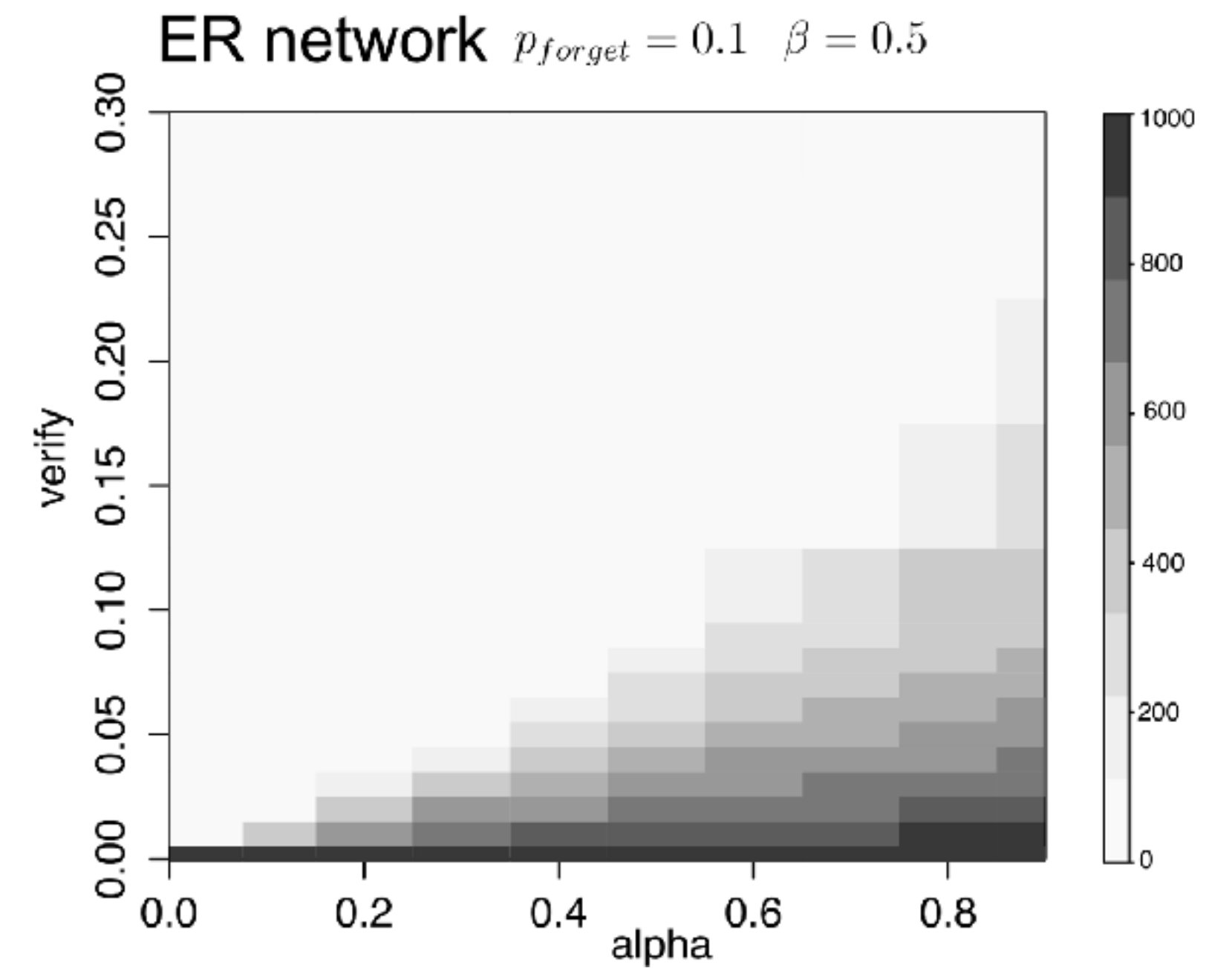
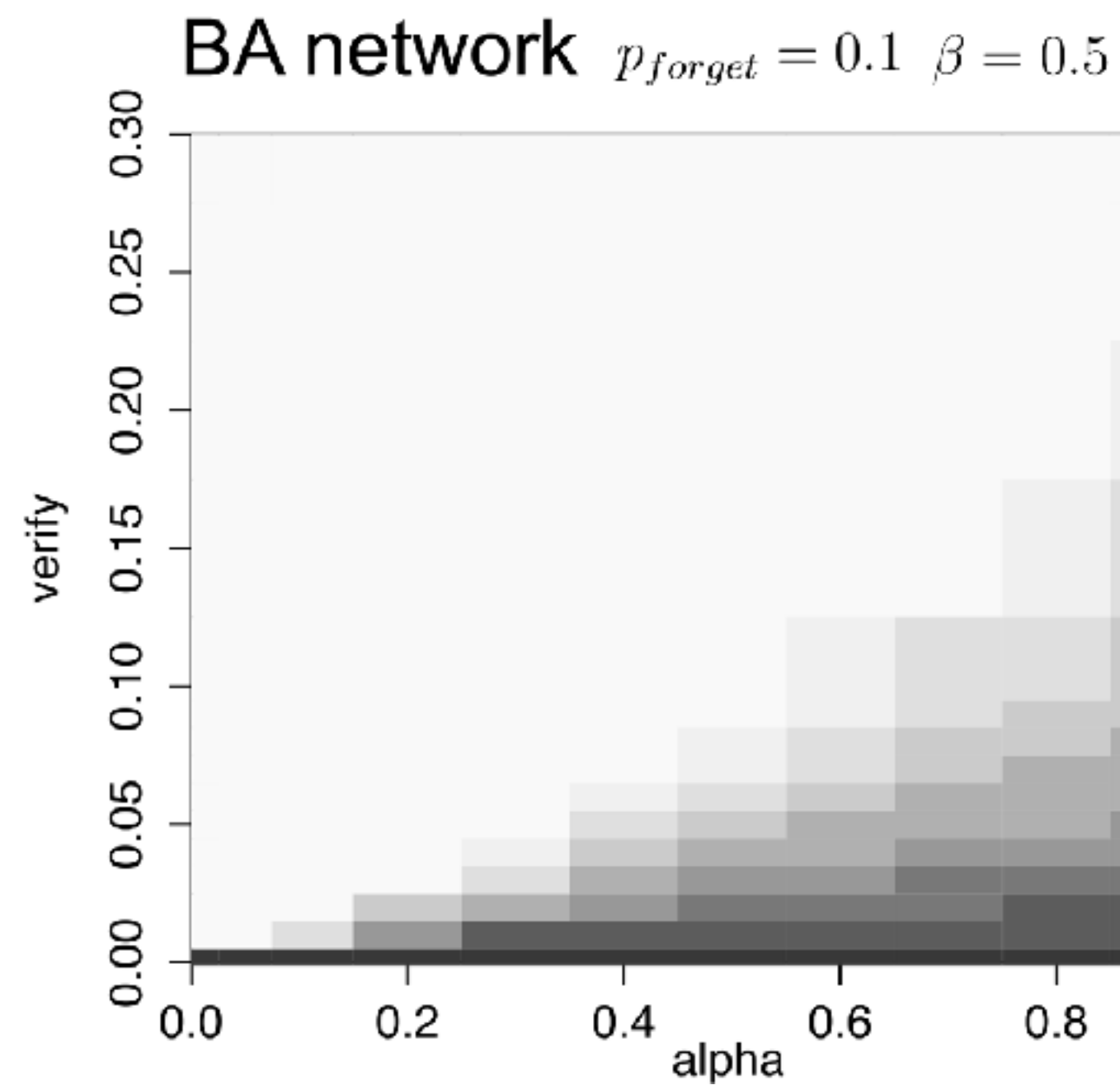
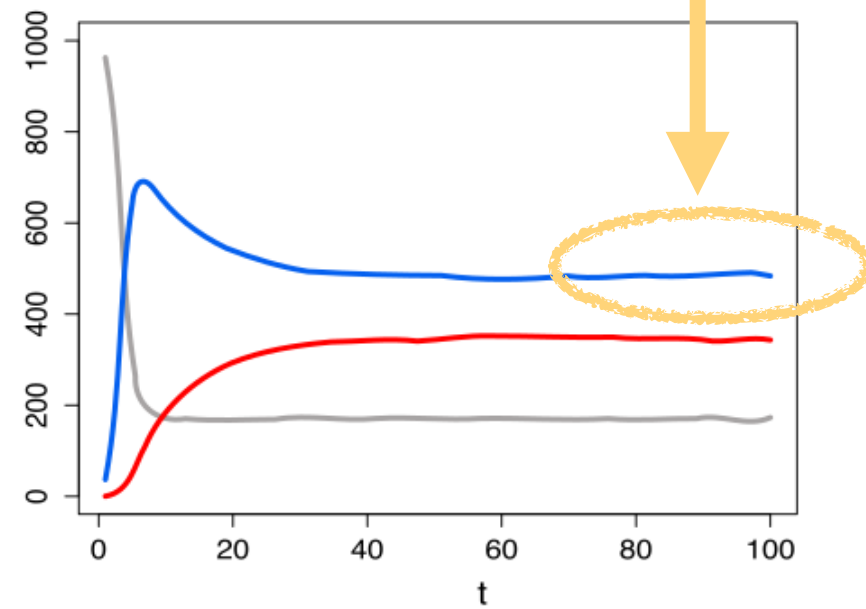
Dynamics (agent-based simulations)



hoax **credibility** and **fact-checking probability** rule hoax persistence in the network

Dynamics (agent-based simulations)

number of 'believers' at the equilibrium



First step toward “good practices” understanding

threshold on verifying probability: our model provides an idea of how many believers we need to convince to guarantee the removal of the hoax

The role of segregation

Skeptical and gullible agents

let's tune **credibility** accordingly

Skeptical and gullible agents

let's tune **credibility** accordingly

α

Skeptical and gullible agents

let's tune **credibility** accordingly



Skeptical and gullible agents

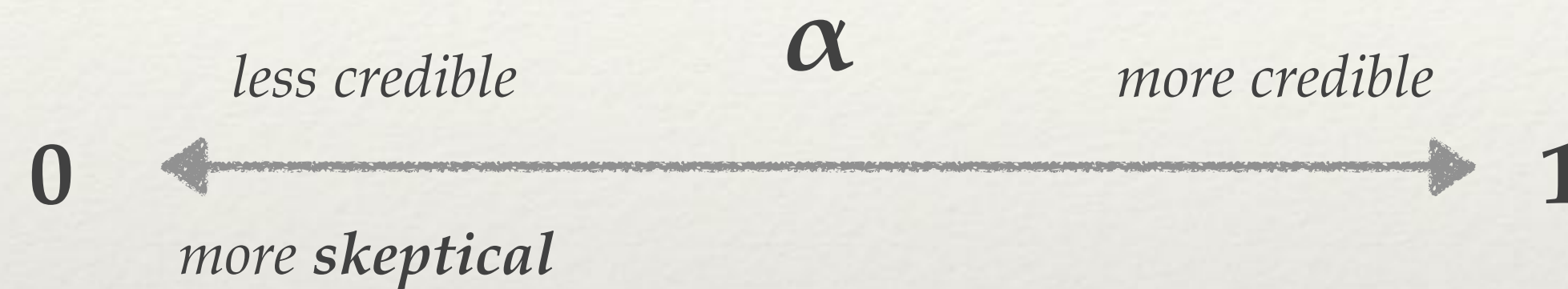
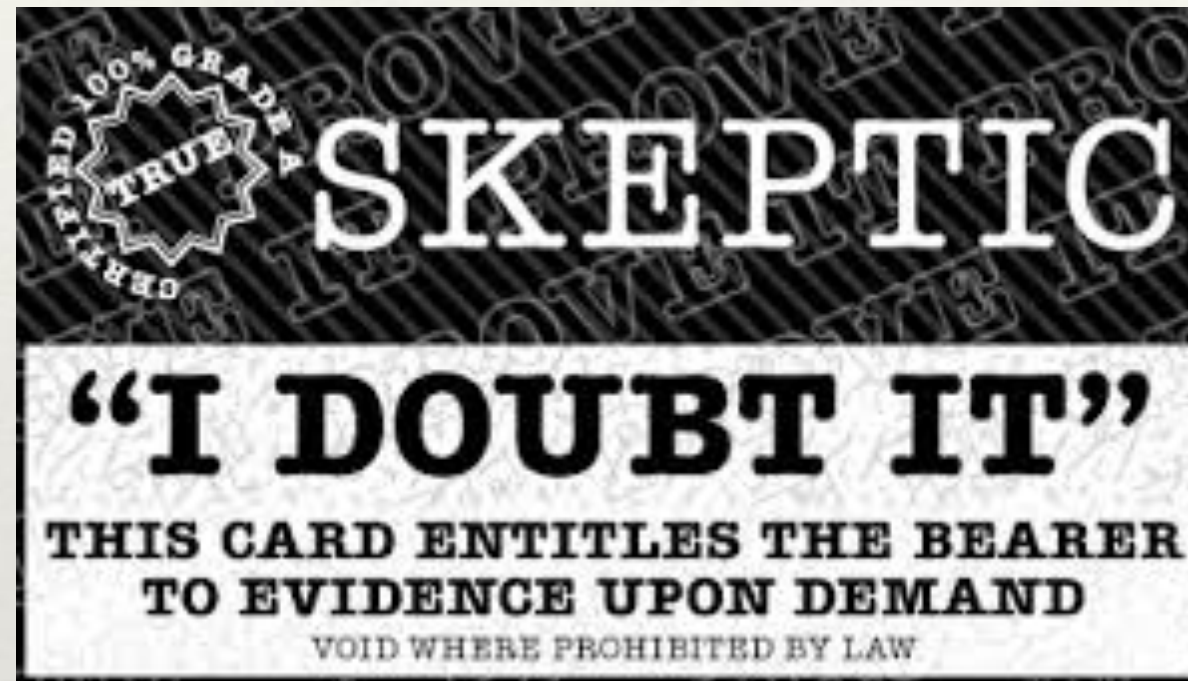
let's tune **credibility** accordingly



the propensity to believe is also a property of the node (**gullibility**)

Skeptical and gullible agents

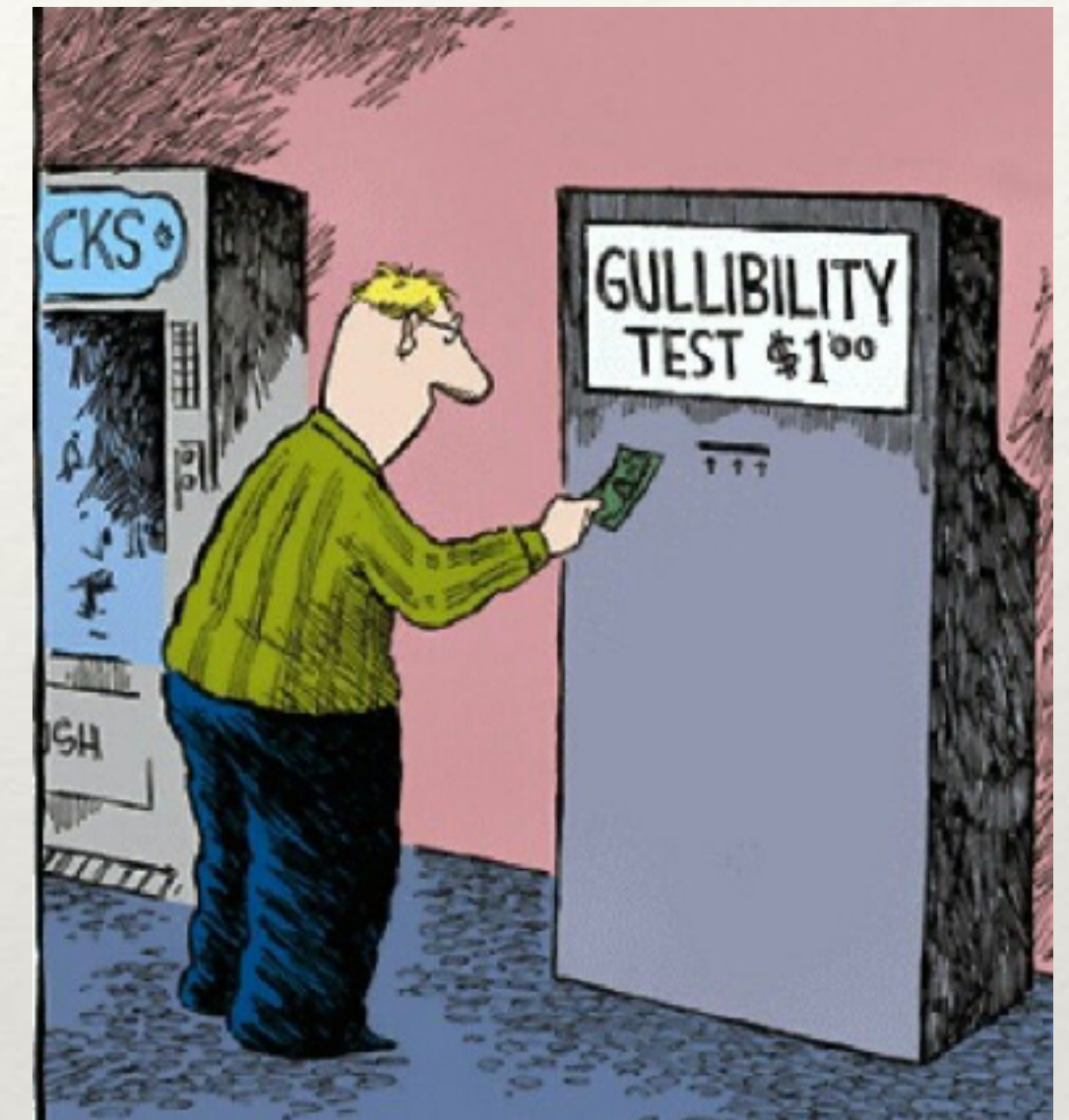
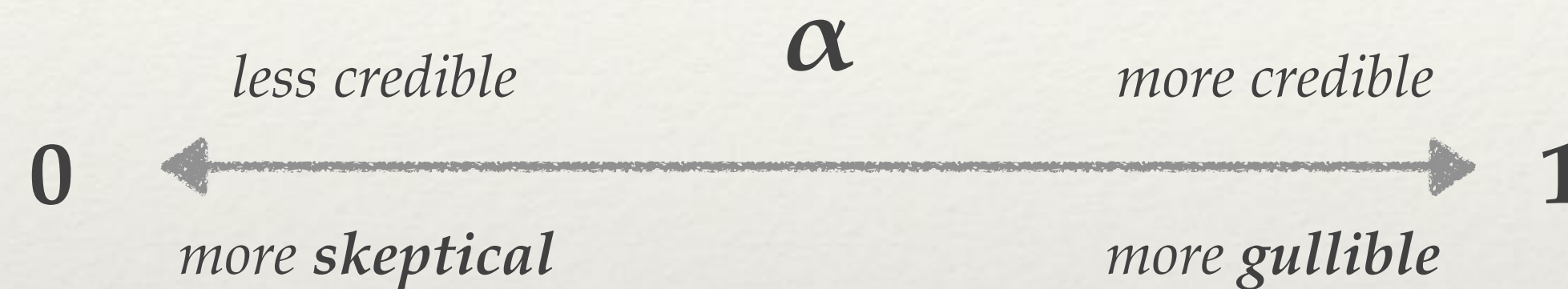
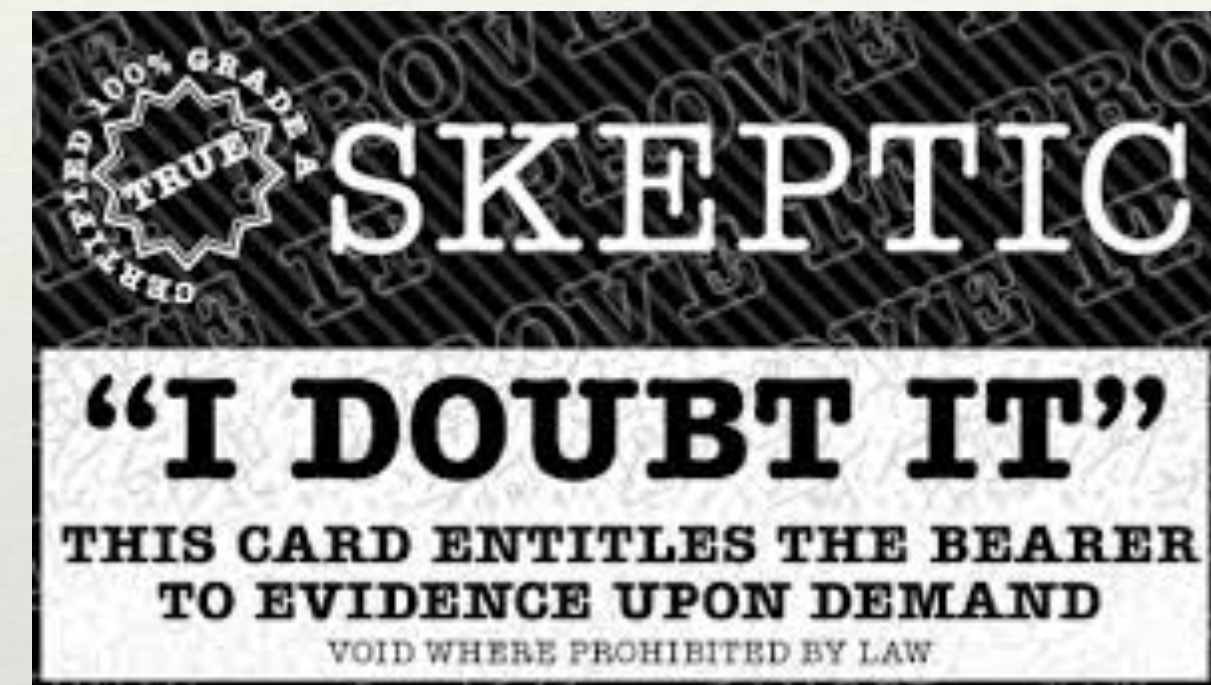
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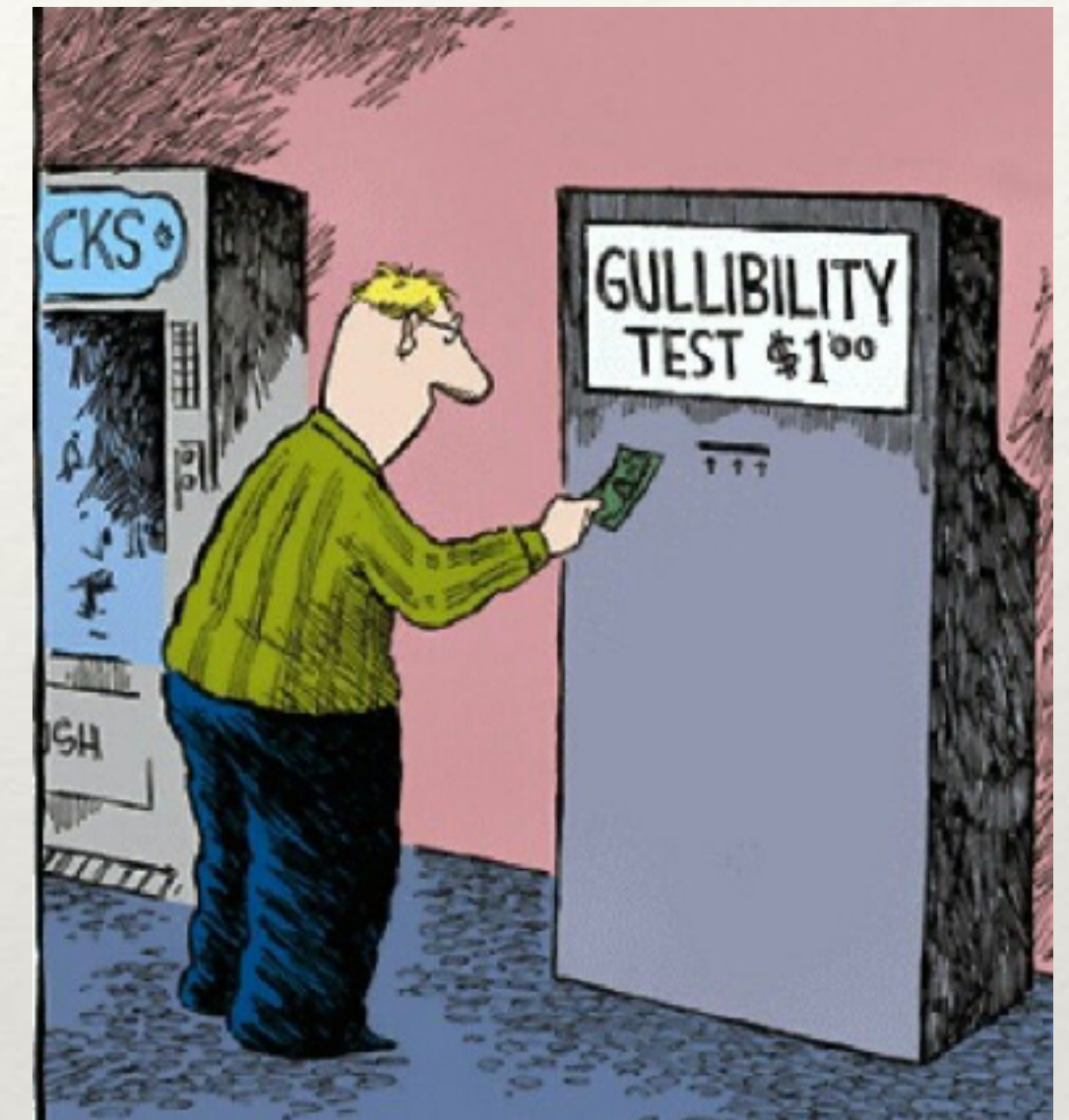
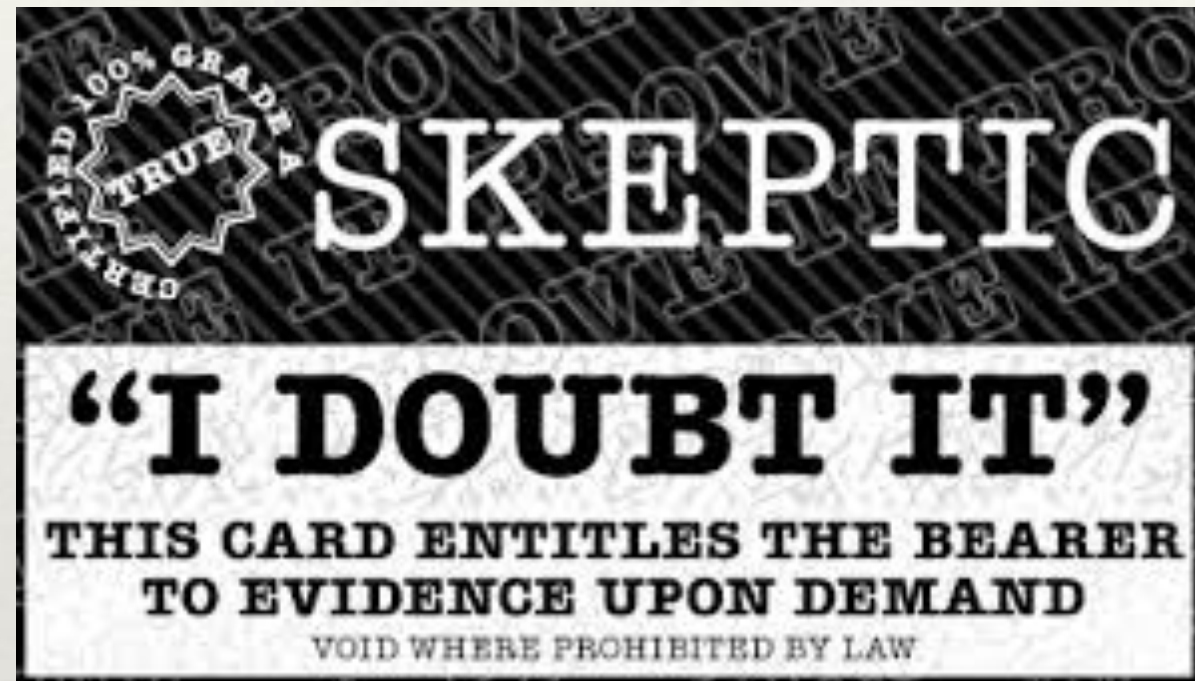
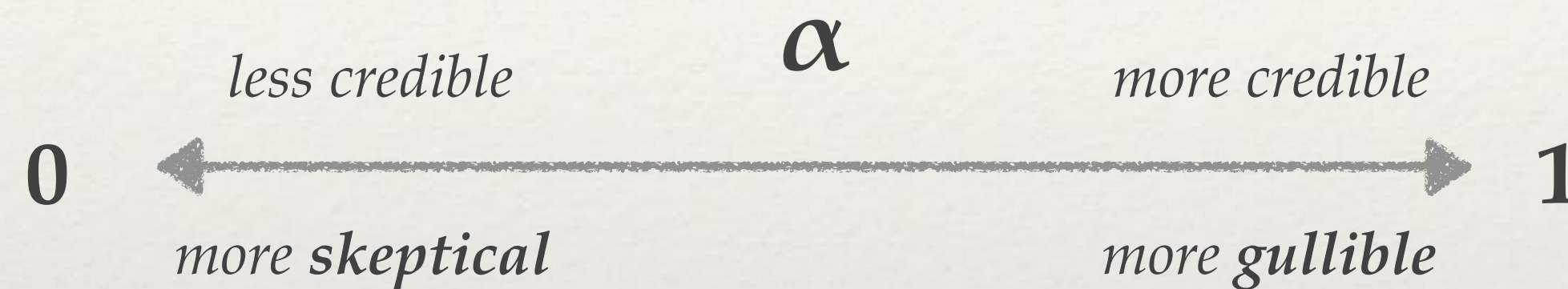
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Skeptical and gullible agents

let's tune credibility accordingly



the propensity to believe is also a property of the node (**gullibility**)

What does it happen when skeptics and gullible agents are segregated?

Modeling two segregated communities

Skeptic



α small

Gullible



α large

Modeling two segregated communities

Skeptic



α small

size ($0 < \gamma < N$)

nodes in the gullible community

Gullible



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size ($0 < \gamma < N$)

nodes in the gullible community

segregation ($0.5 < s < 1$)

fraction of edges within same community

[Gu-Gu, Sk-Sk]

Gullible



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Modeling two segregated communities

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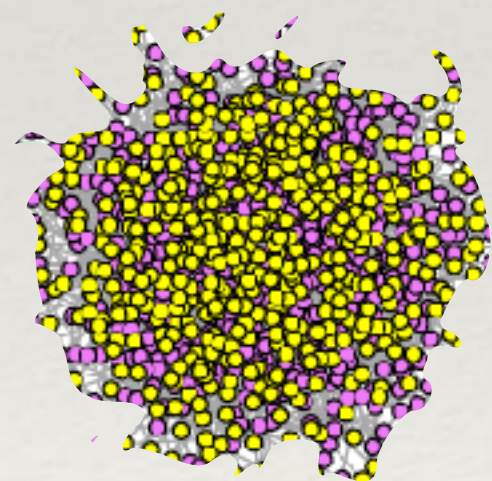
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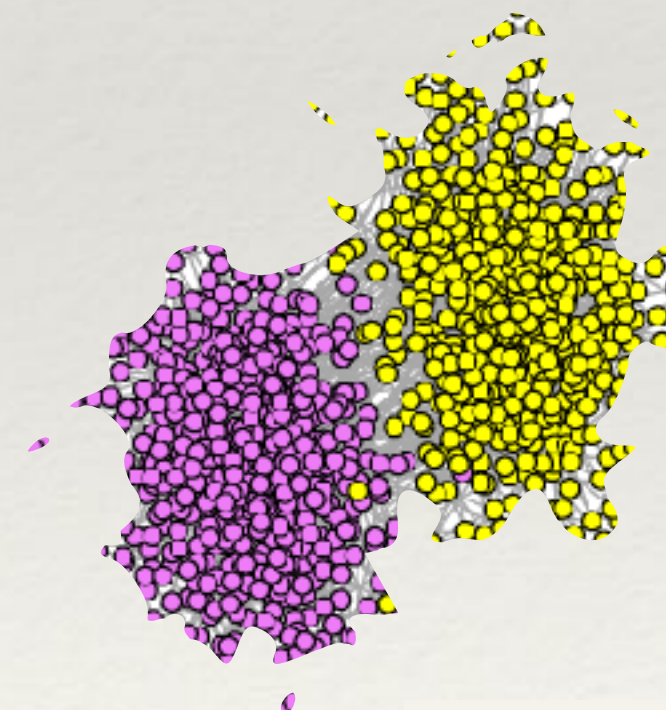
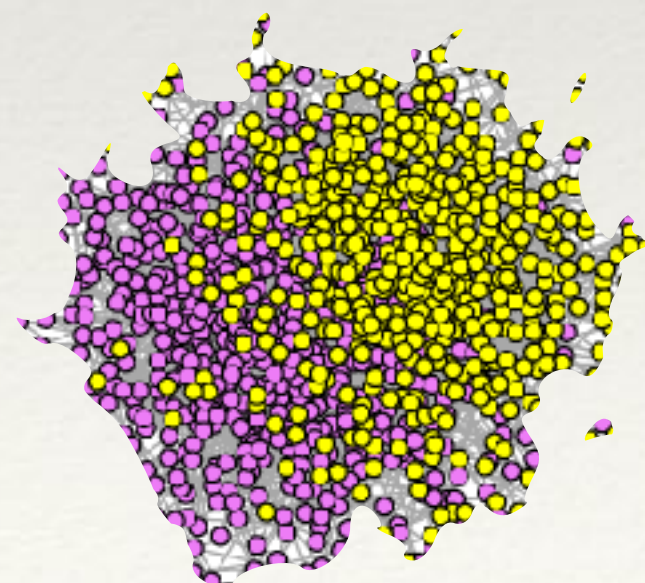


$s=0.55$

$\gamma=500$

$s=0.8$

$\gamma=500$

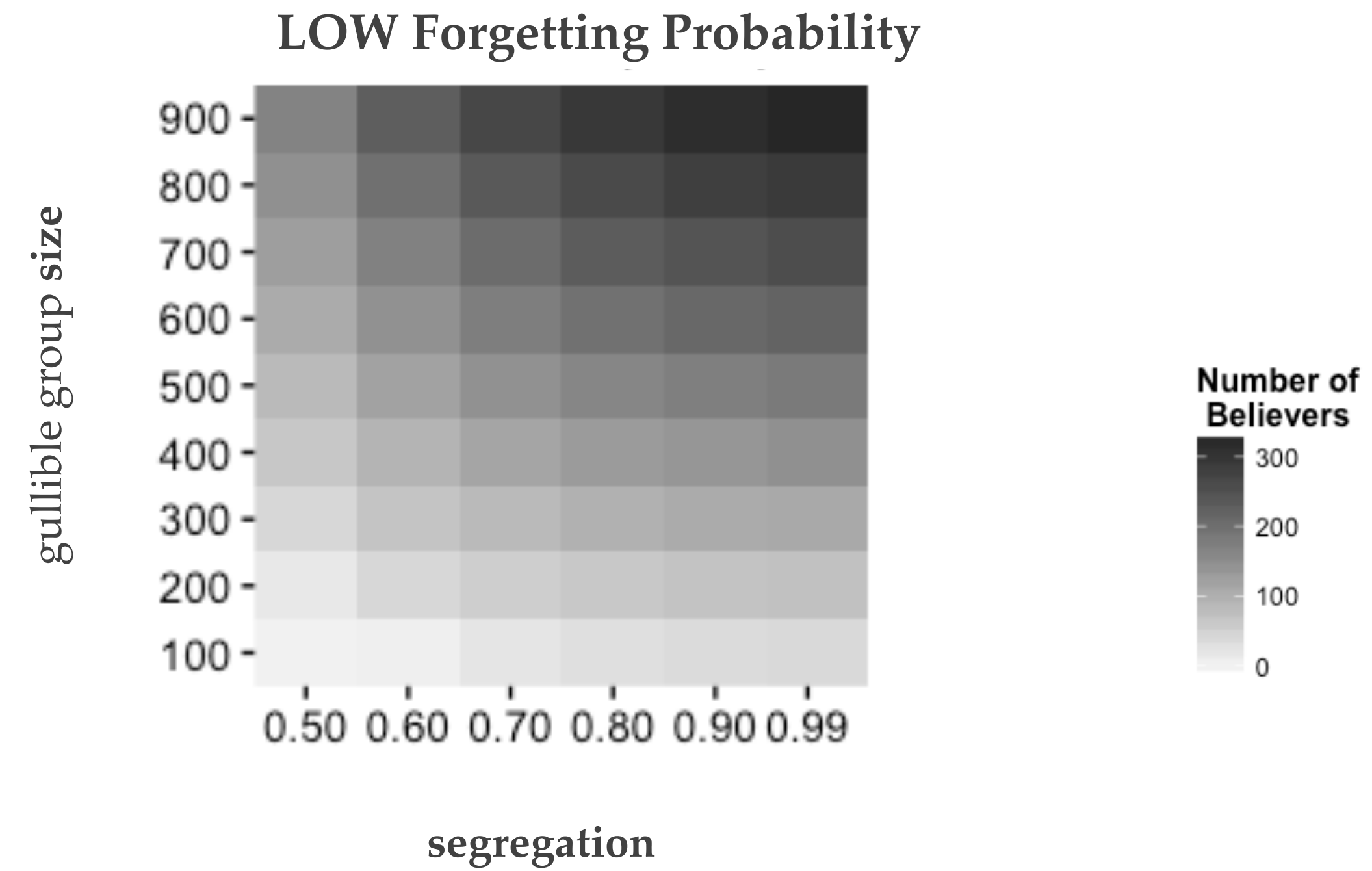


$s=0.95$

$\gamma=500$

Size vs segregation

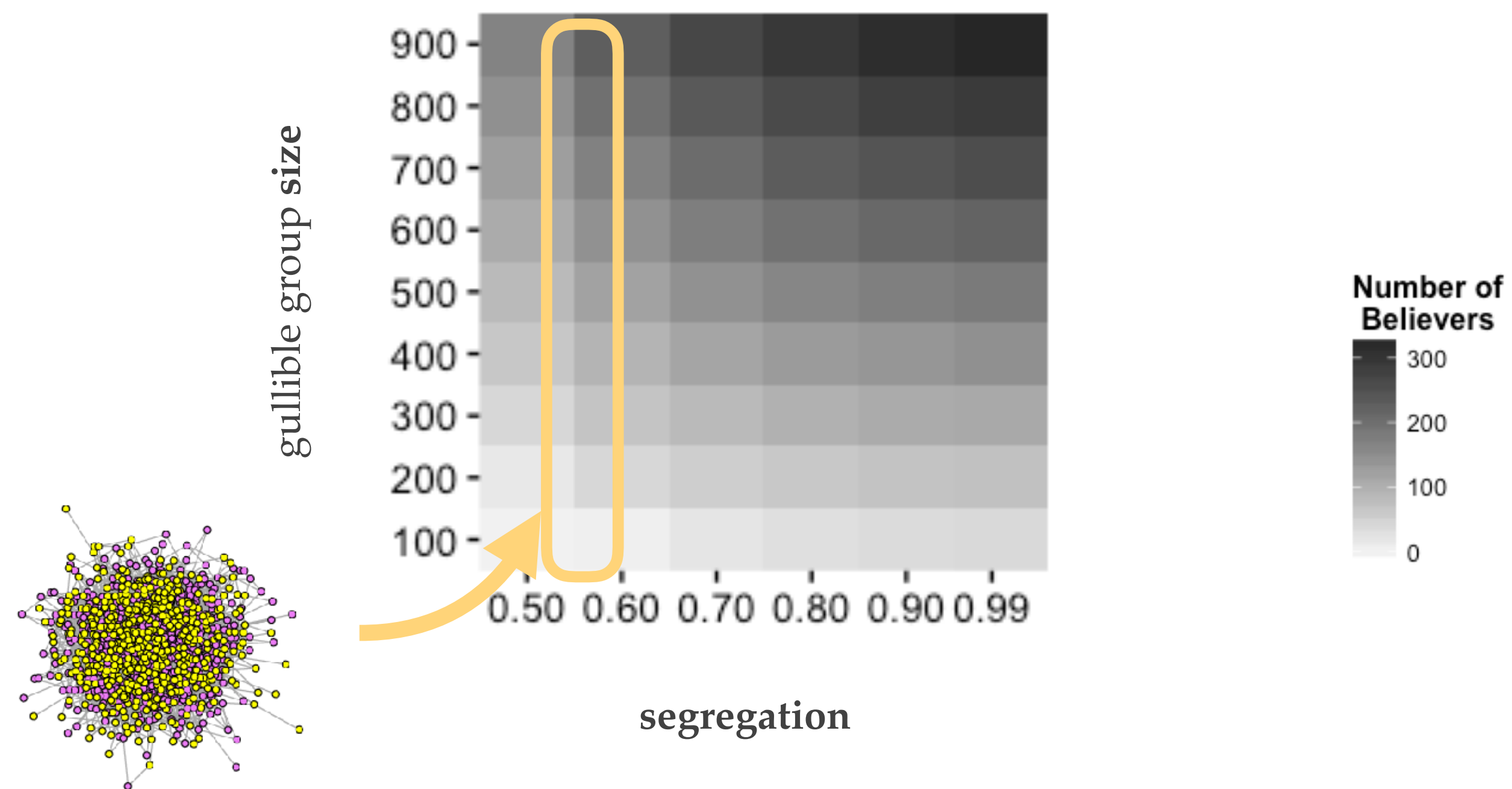
$$p_f = 0.1$$



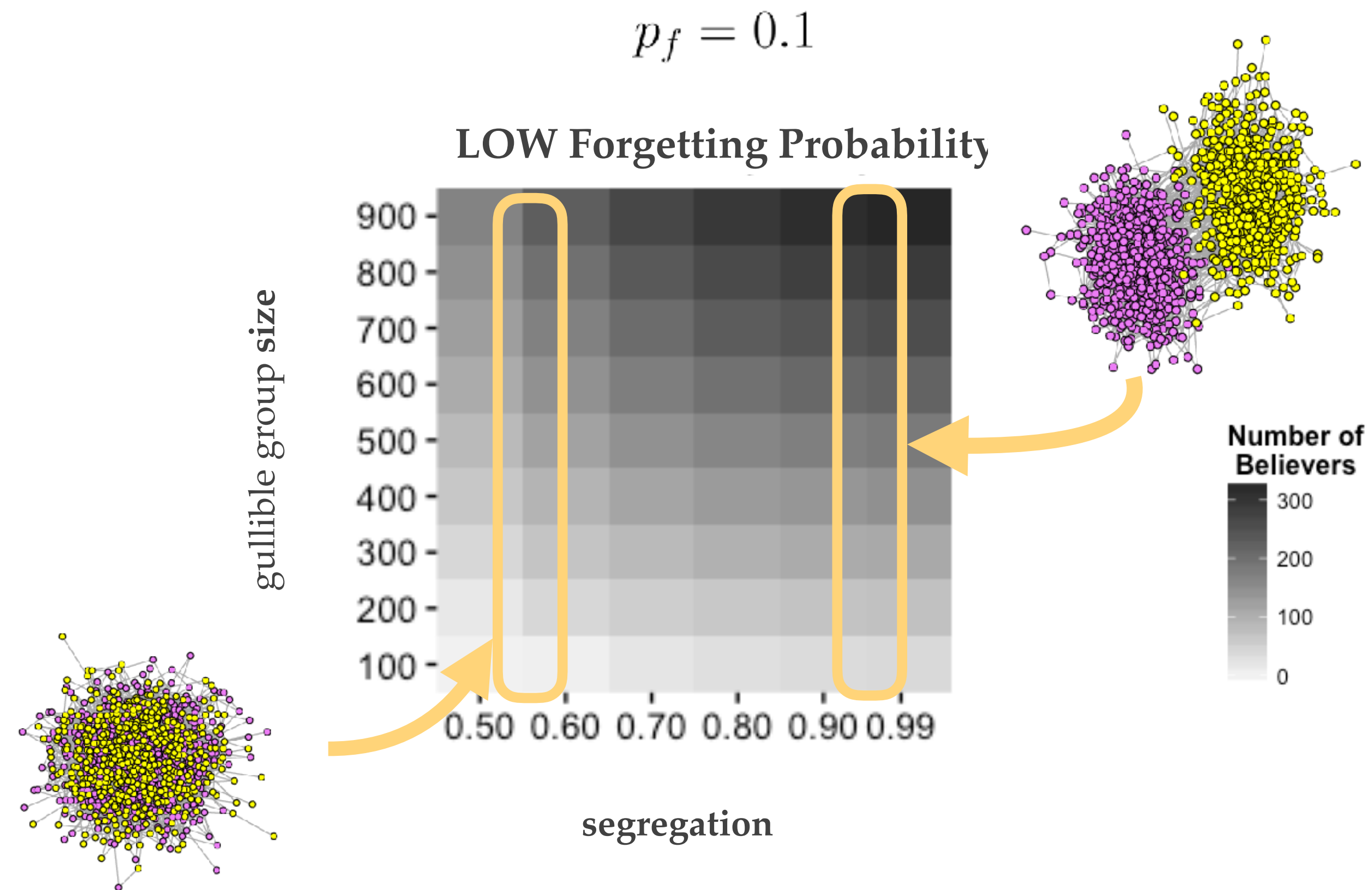
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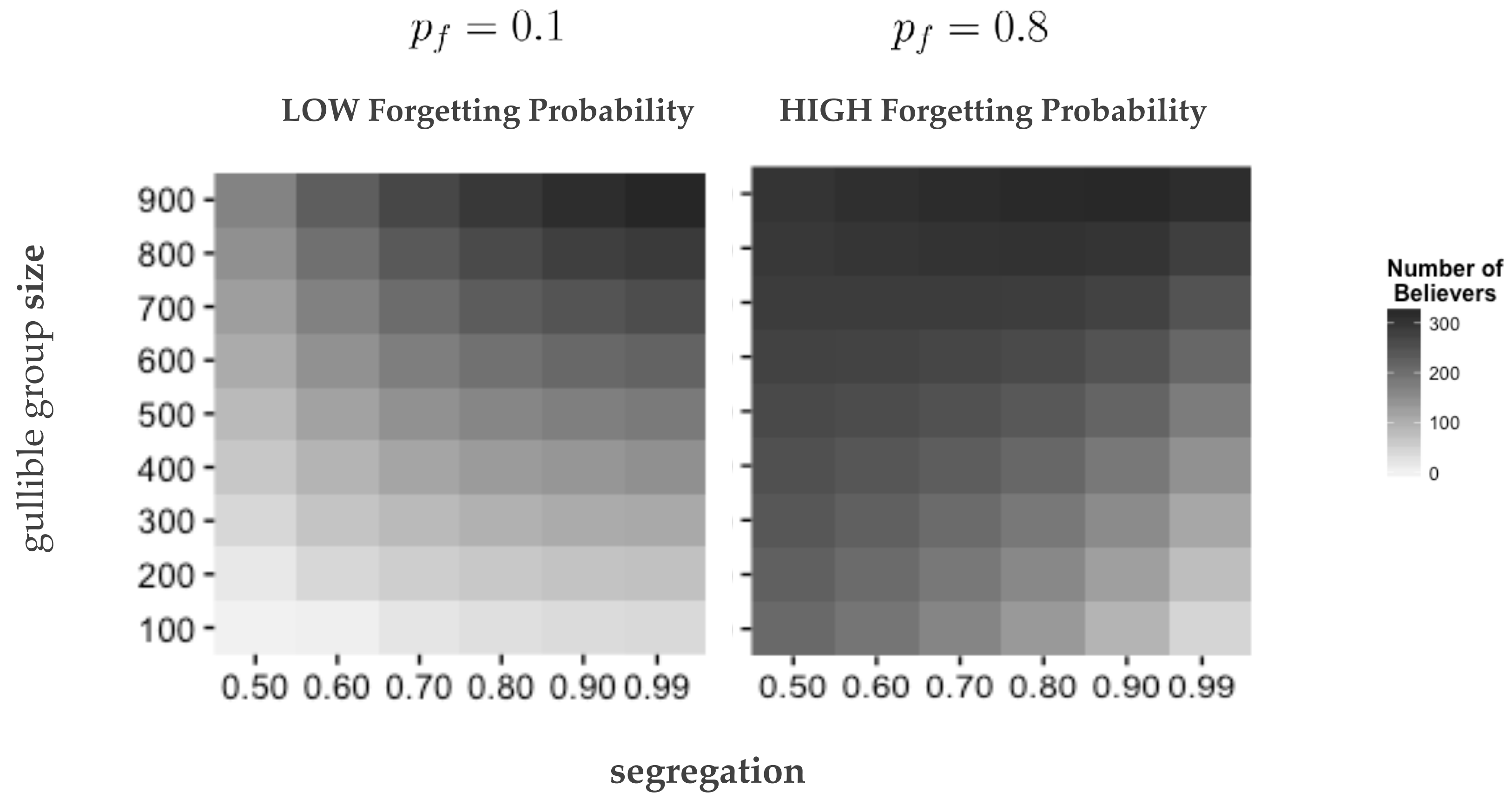
LOW Forgetting Probability



Size vs segregation



Size vs segregation



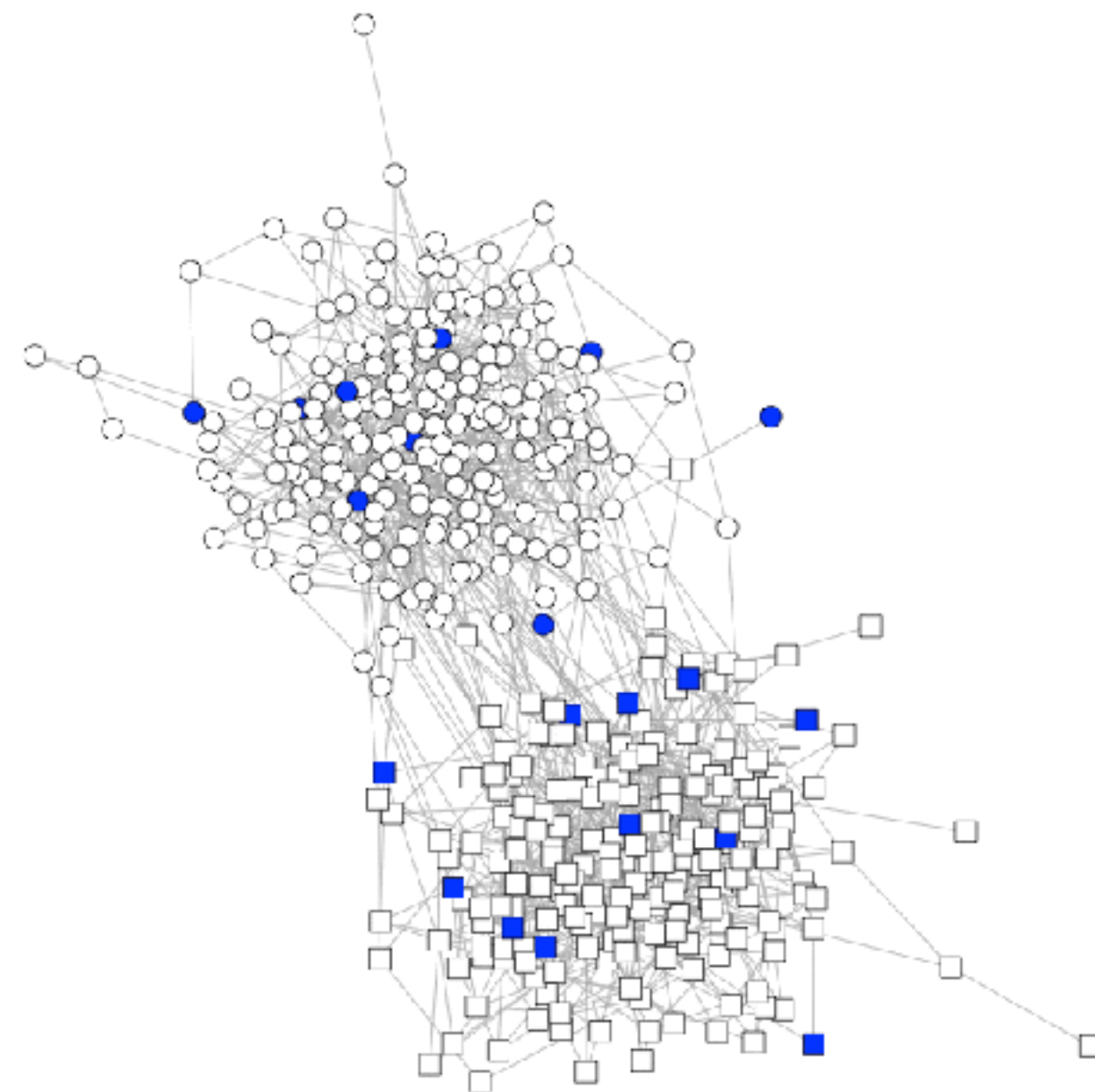
Role of forgetting

LOW Forgetting Rate

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HIGH Forgetting Rate

$$p_f = 0.8$$



Time = 1

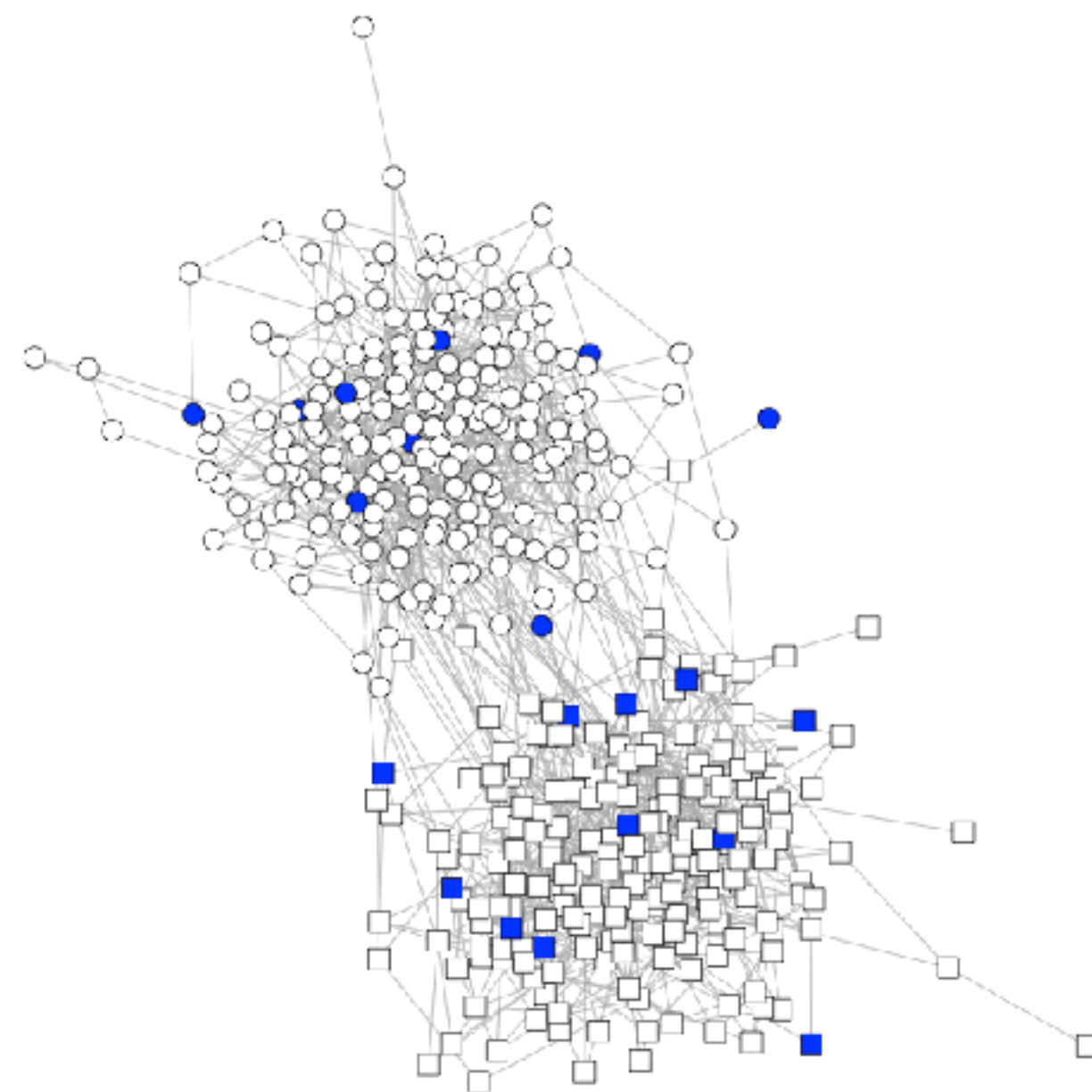
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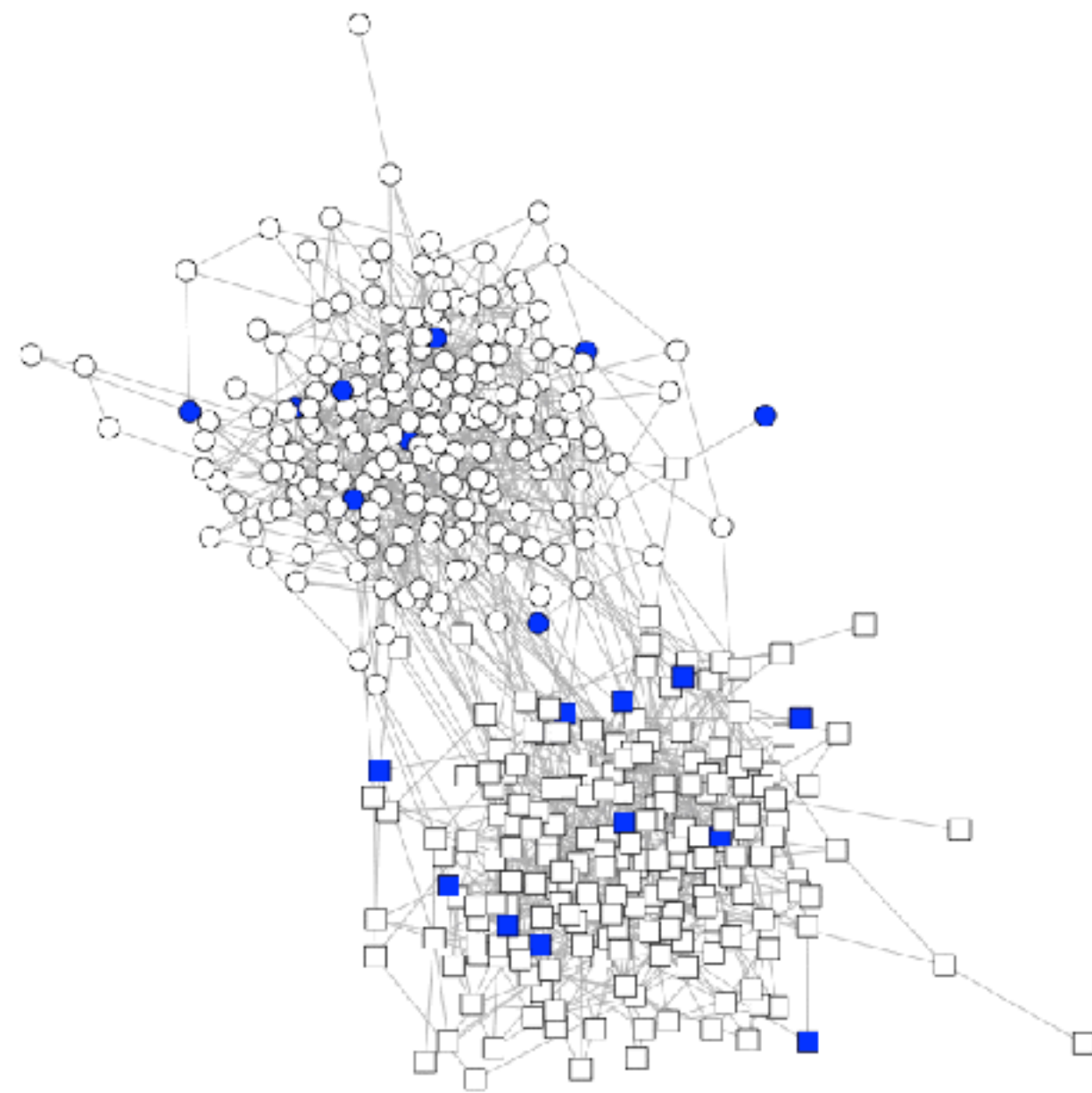


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Role of forgetting

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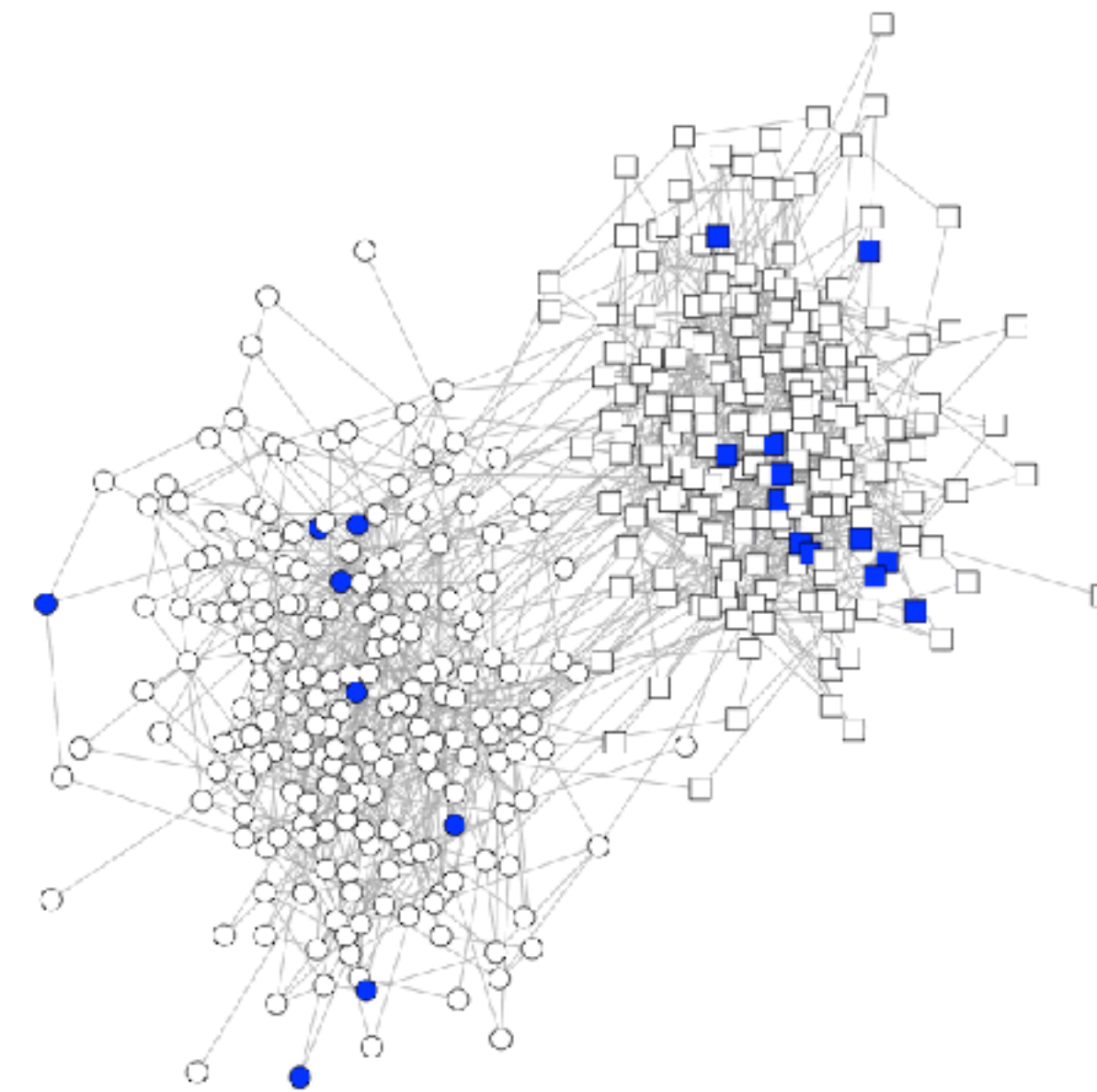
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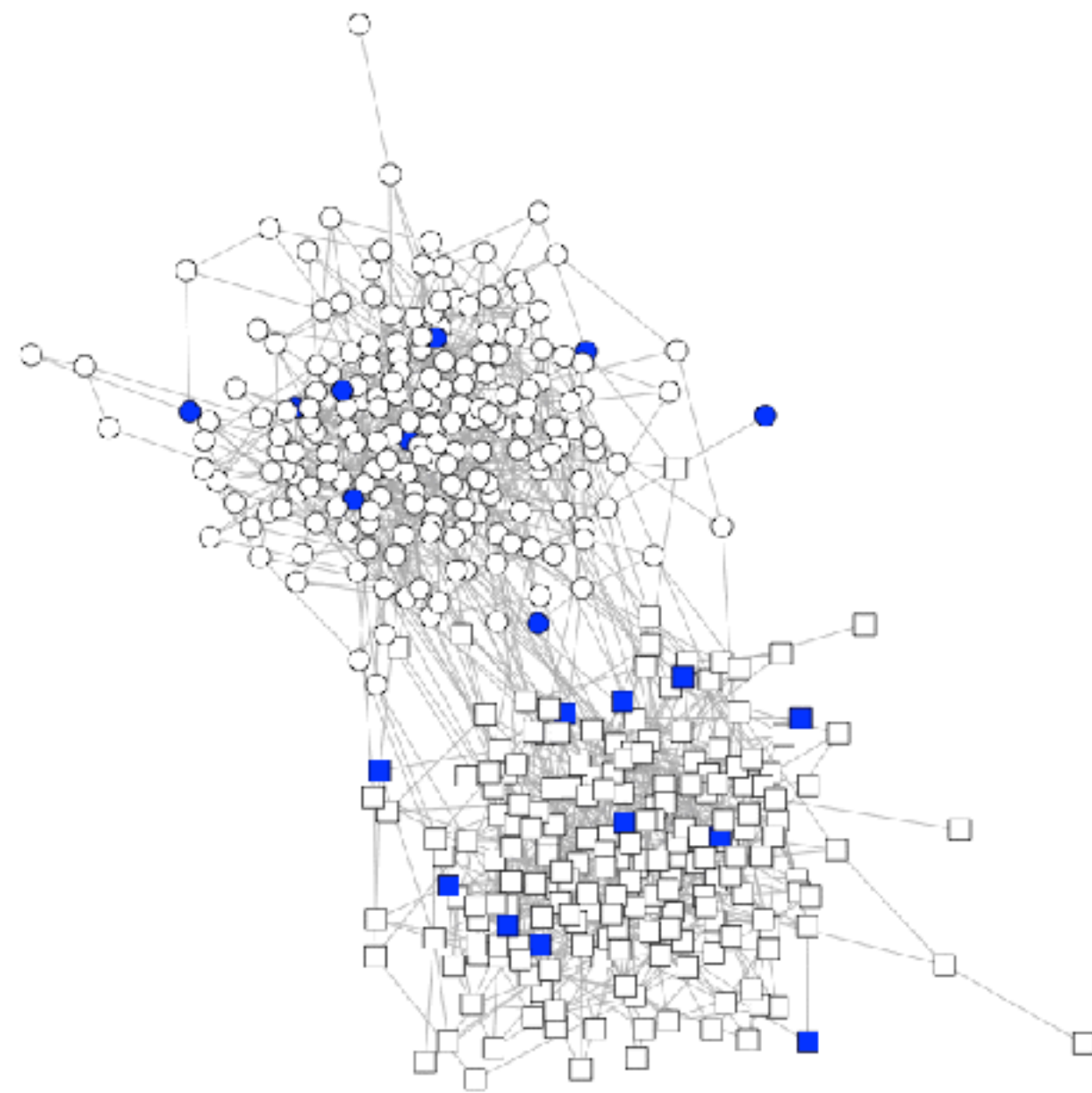


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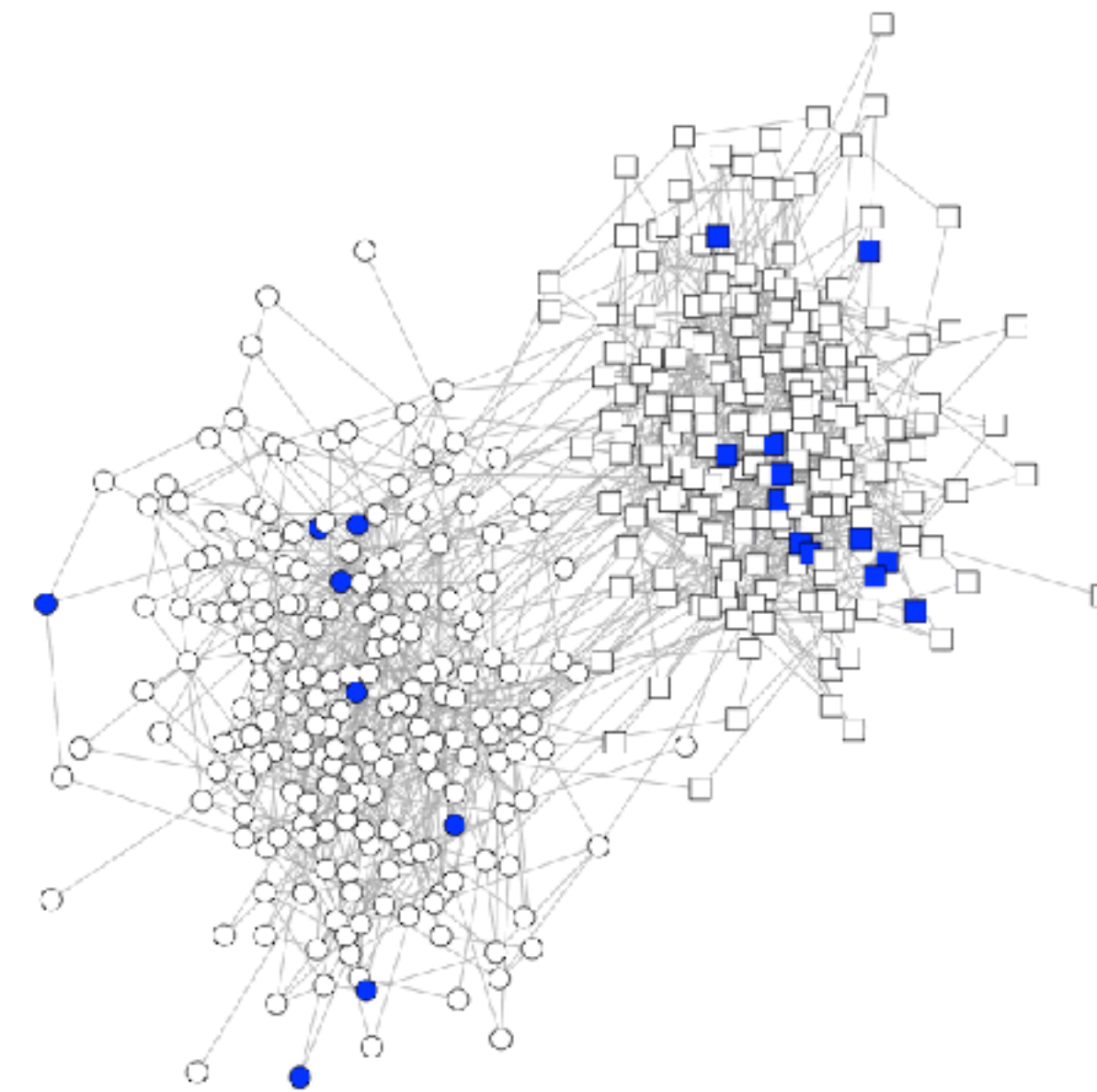
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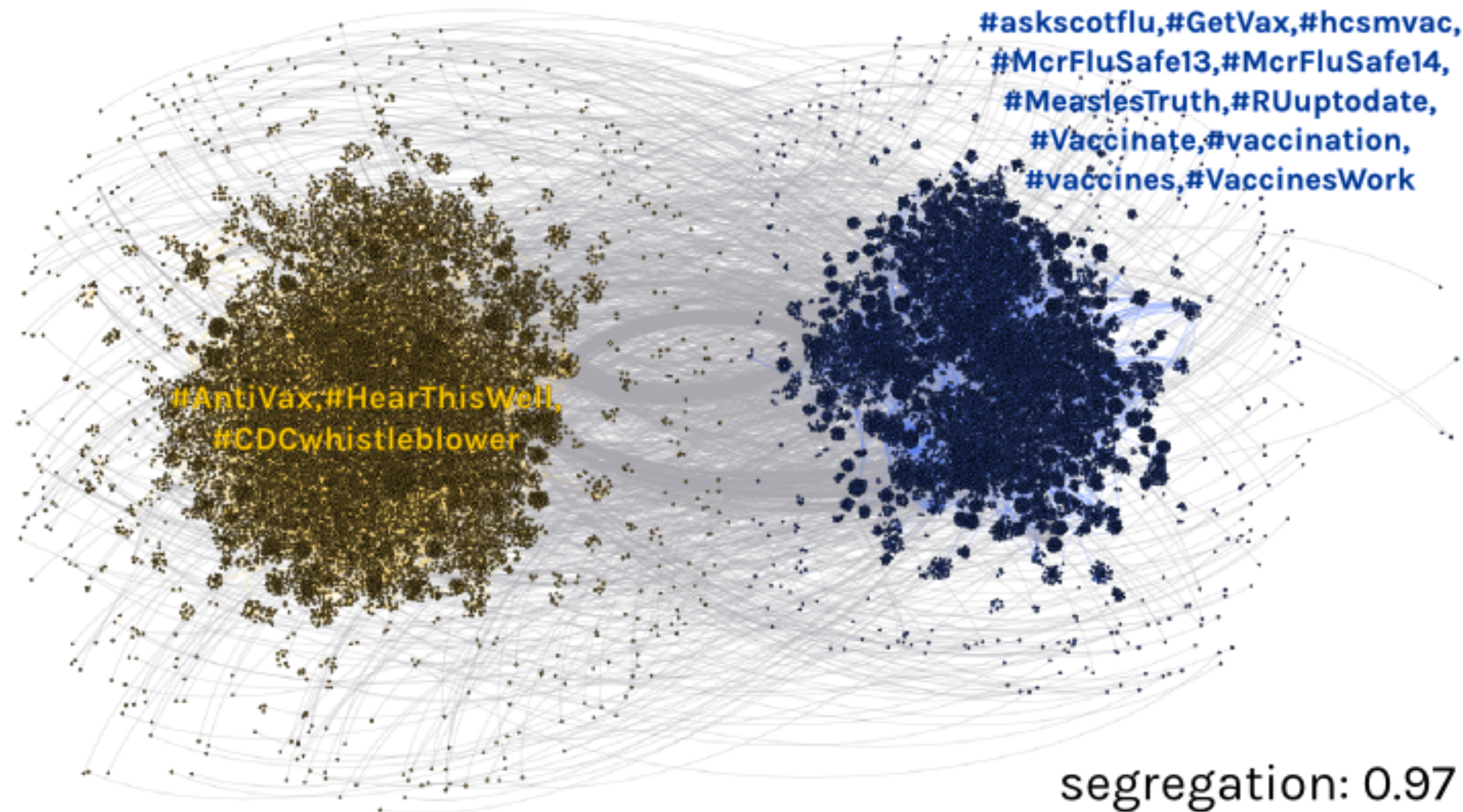
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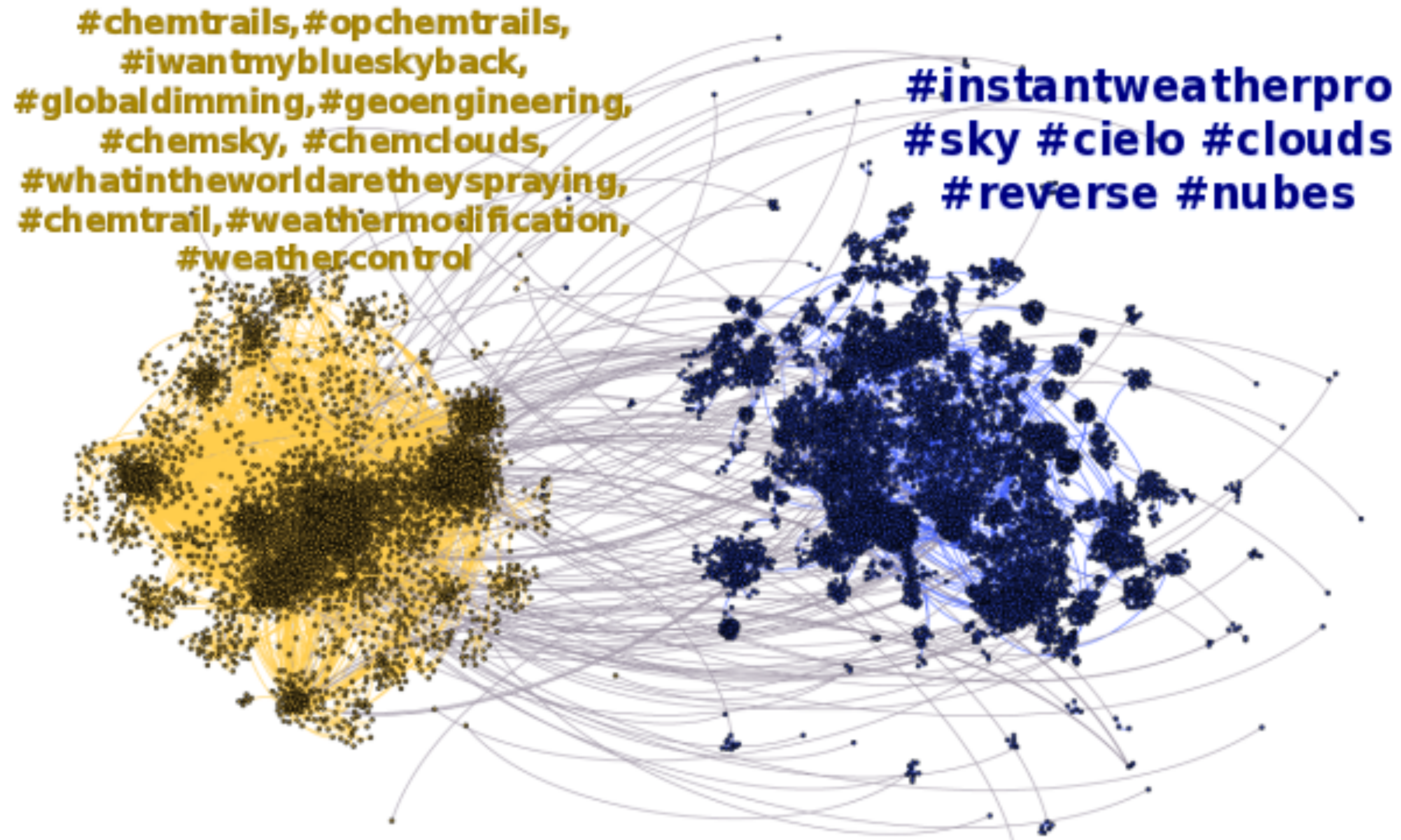
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 - ❖ **low forgetting probability** (e.g., conspiracy theories or partisanship beliefs) requires **low segregation**

real data: vaccines



twitter data from IU <https://osome.iuni.iu.edu>

real data: chemtrails



twitter data from IU <https://osome.iuni.iu.edu>

segregation: 0.99

Evaluating debunking strategies

What-if analysis

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 - ❖ they can still forget
 - ❖ we can accept to leave half of the population in their own (false) beliefs, but we want at least to protect the skeptics!

Basic settings with no verification

Setting

Simulation start

Simulation results

Basic settings with no verification

Setting

segregation: 0.92 (high)

forgetting: 0.1 (low)

gullible group:

- α : 0.8
- seeders B: 10%

skeptical group:

- α : 0.3
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Simulation start

Simulation results

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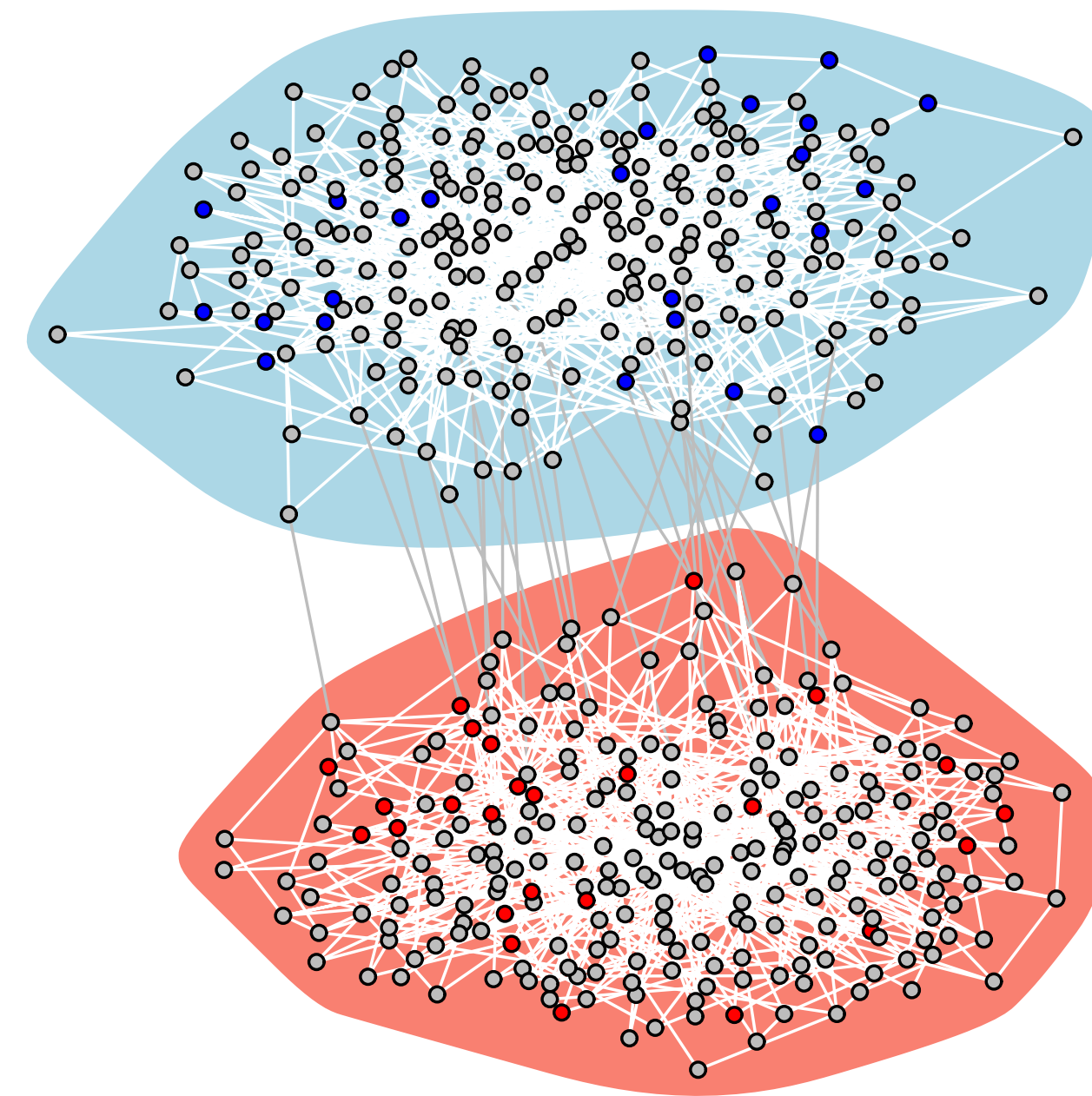
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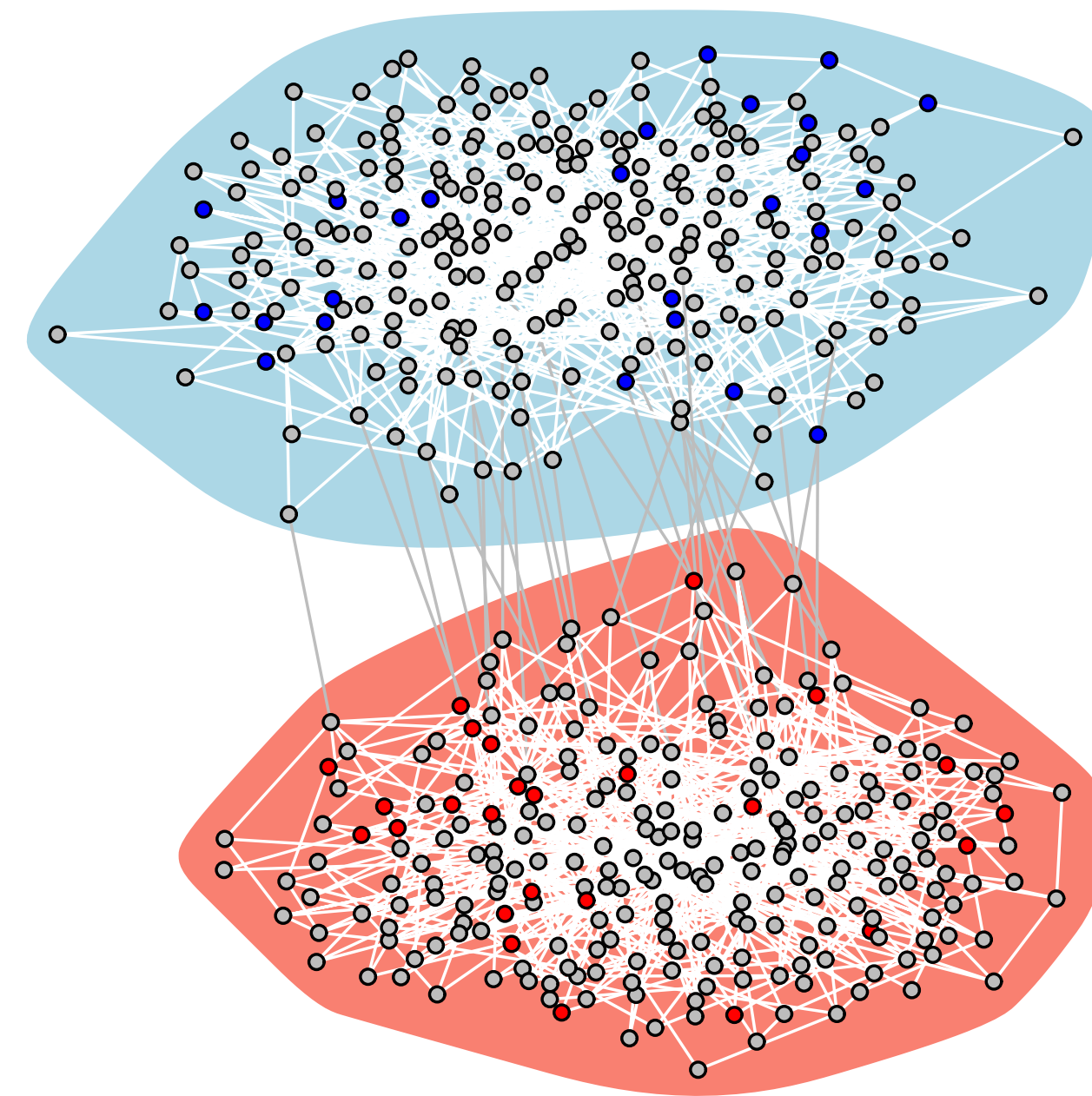
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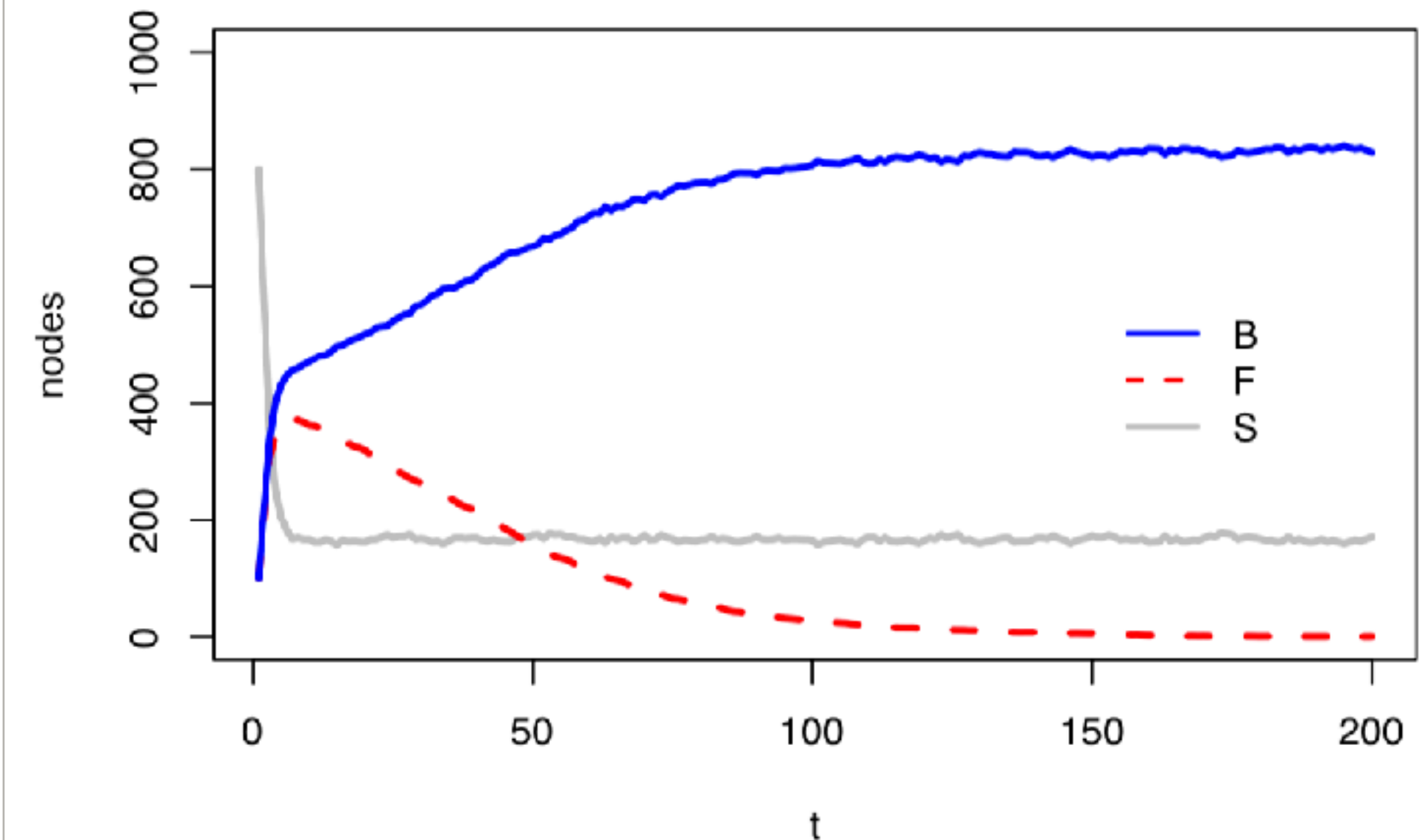
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Simulation start



Simulation results



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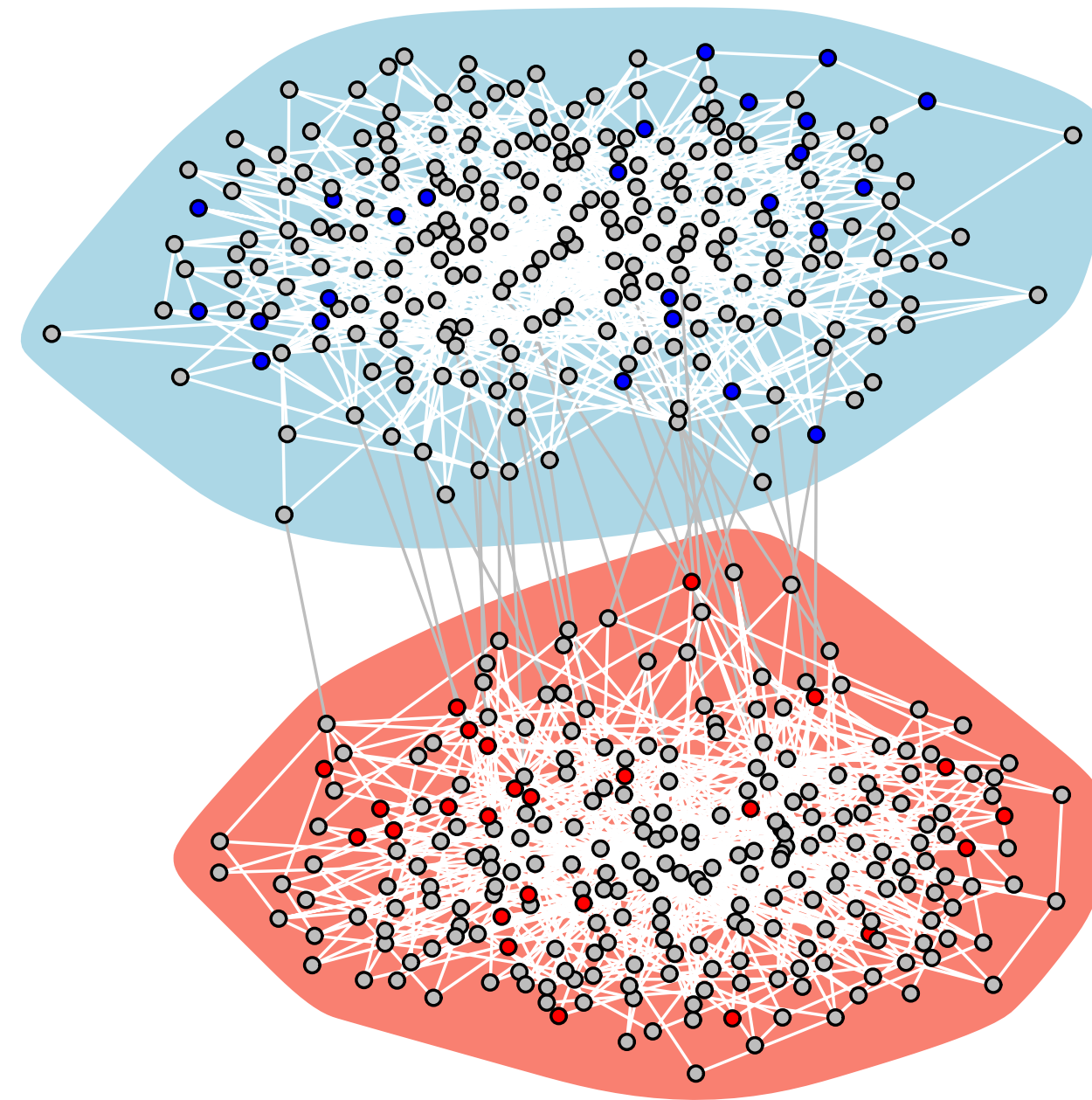
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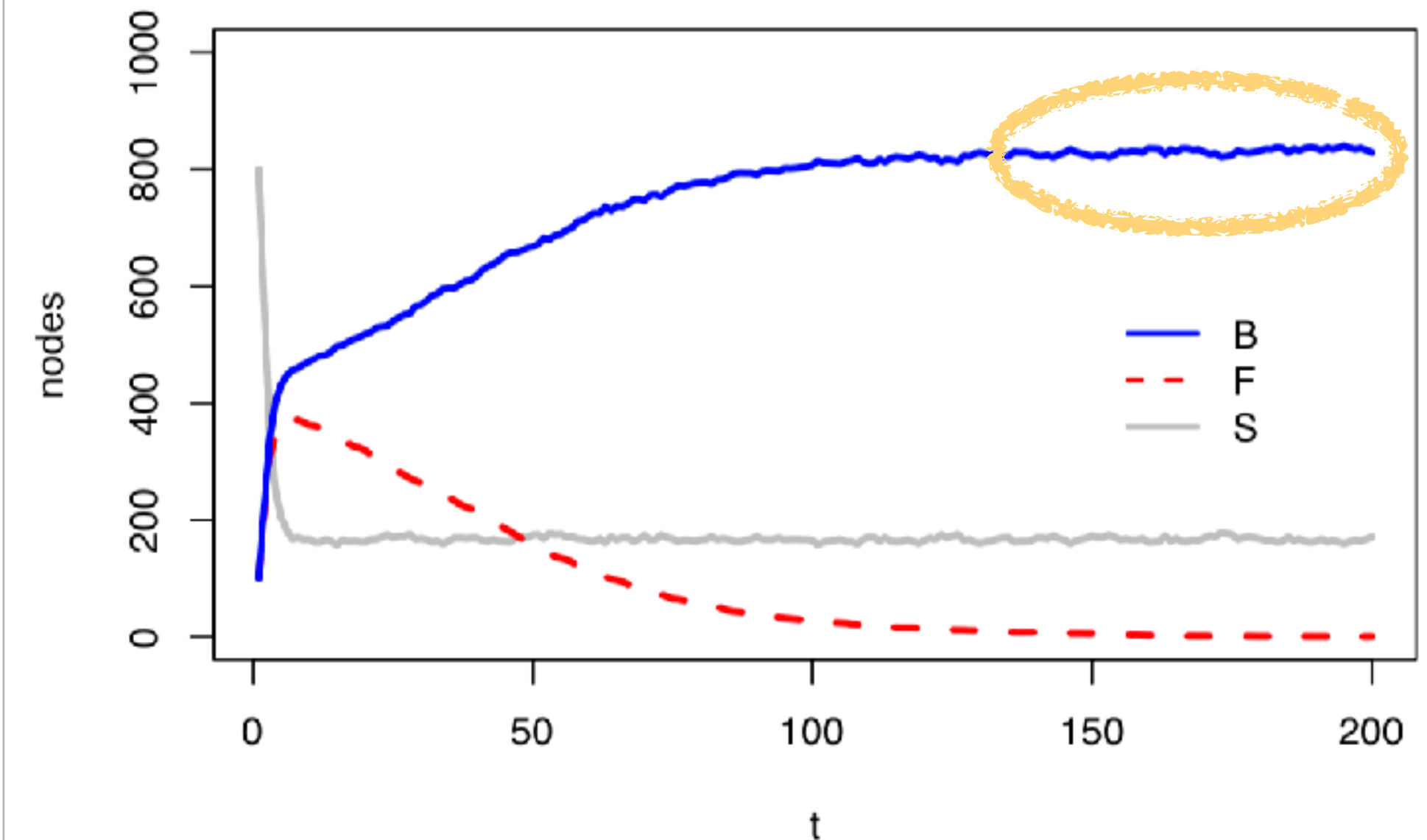
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Simulation start



Simulation results



As expected: very **bad!**

Eternal fact-checkers placed at random

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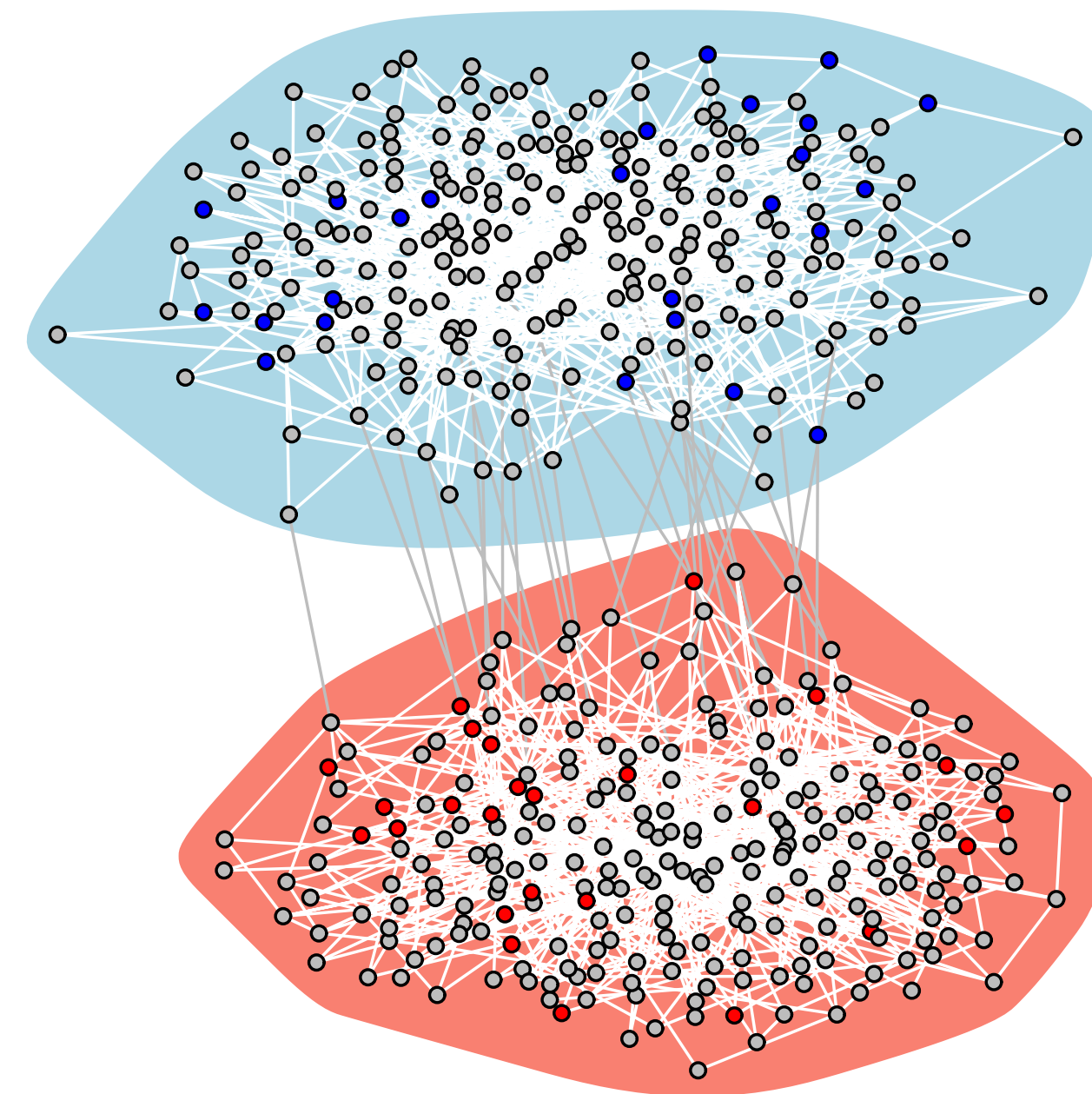
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- **seeders are eFC**

Simulation start



Simulation results

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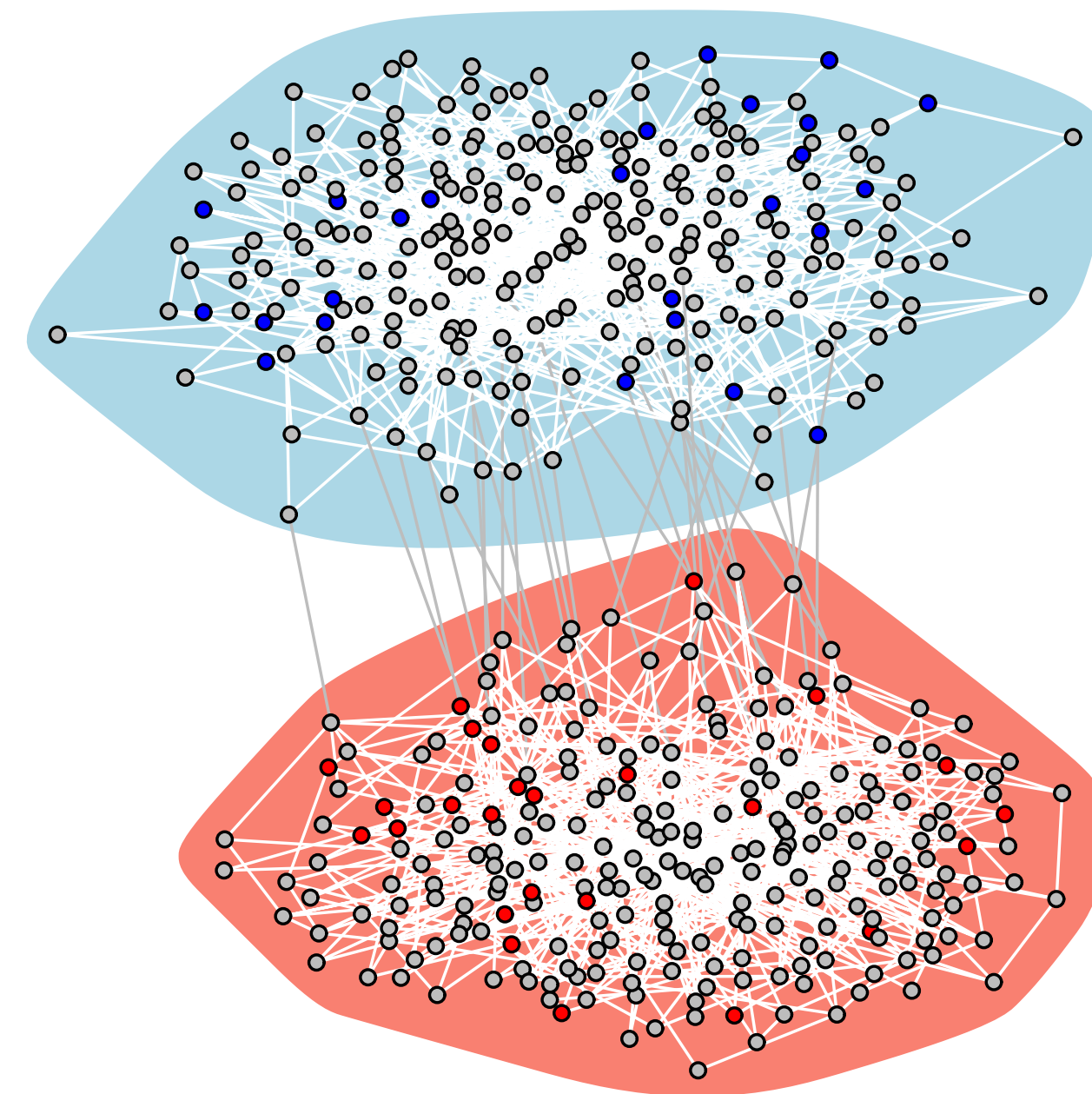
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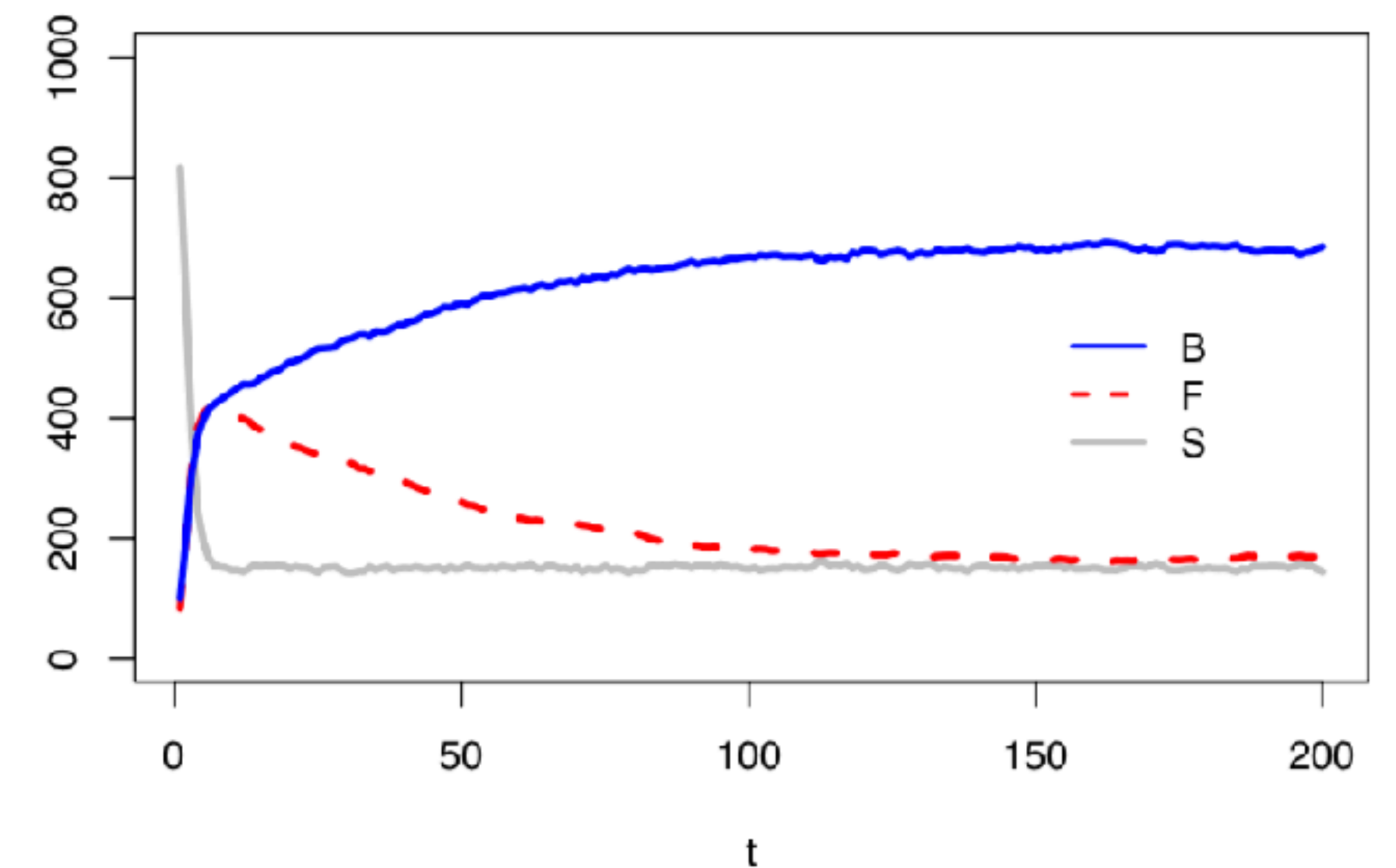
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Simulation results



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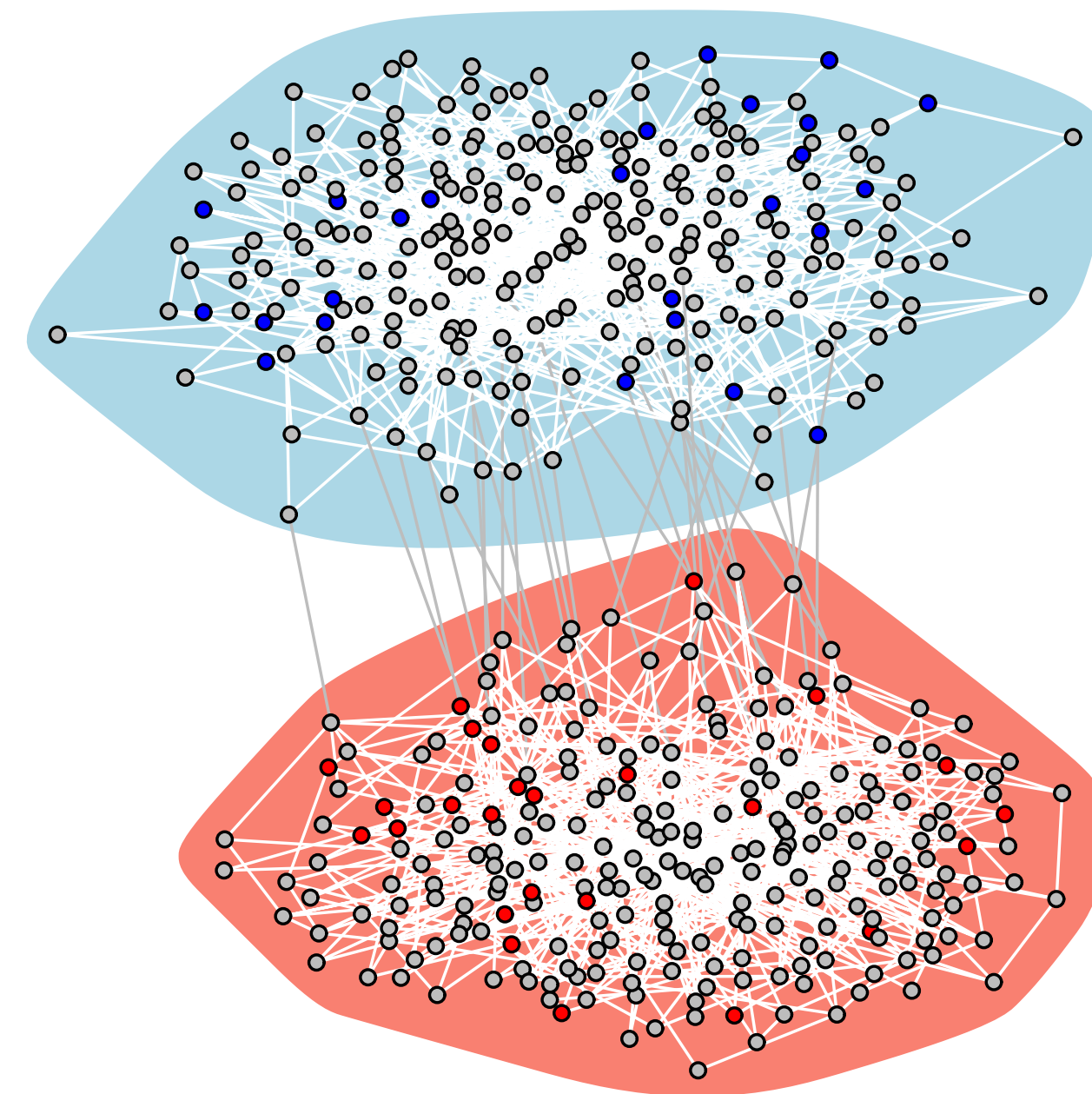
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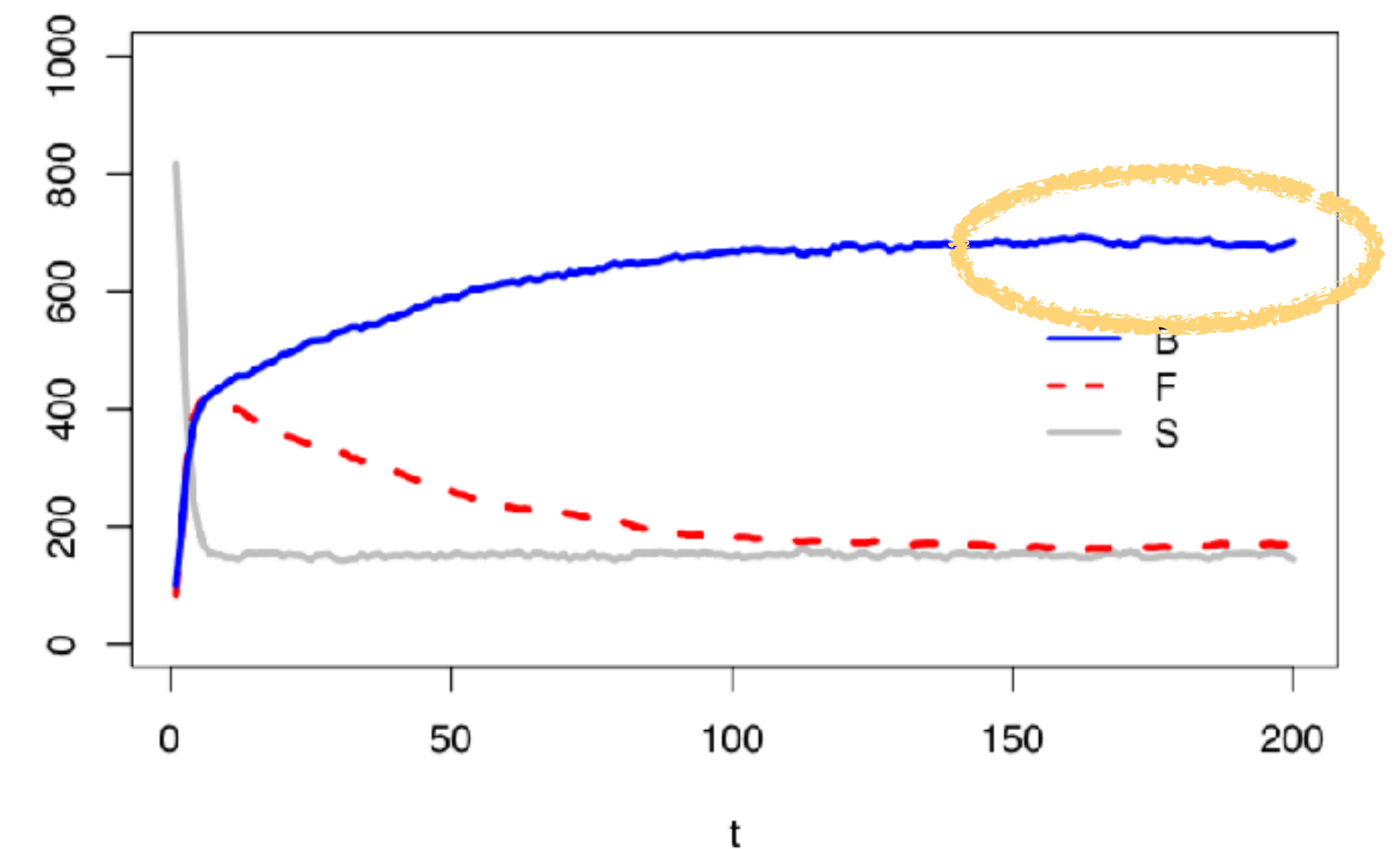
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Simulation start



Simulation results



better, but still...

Hubs as eternal fact-checkers

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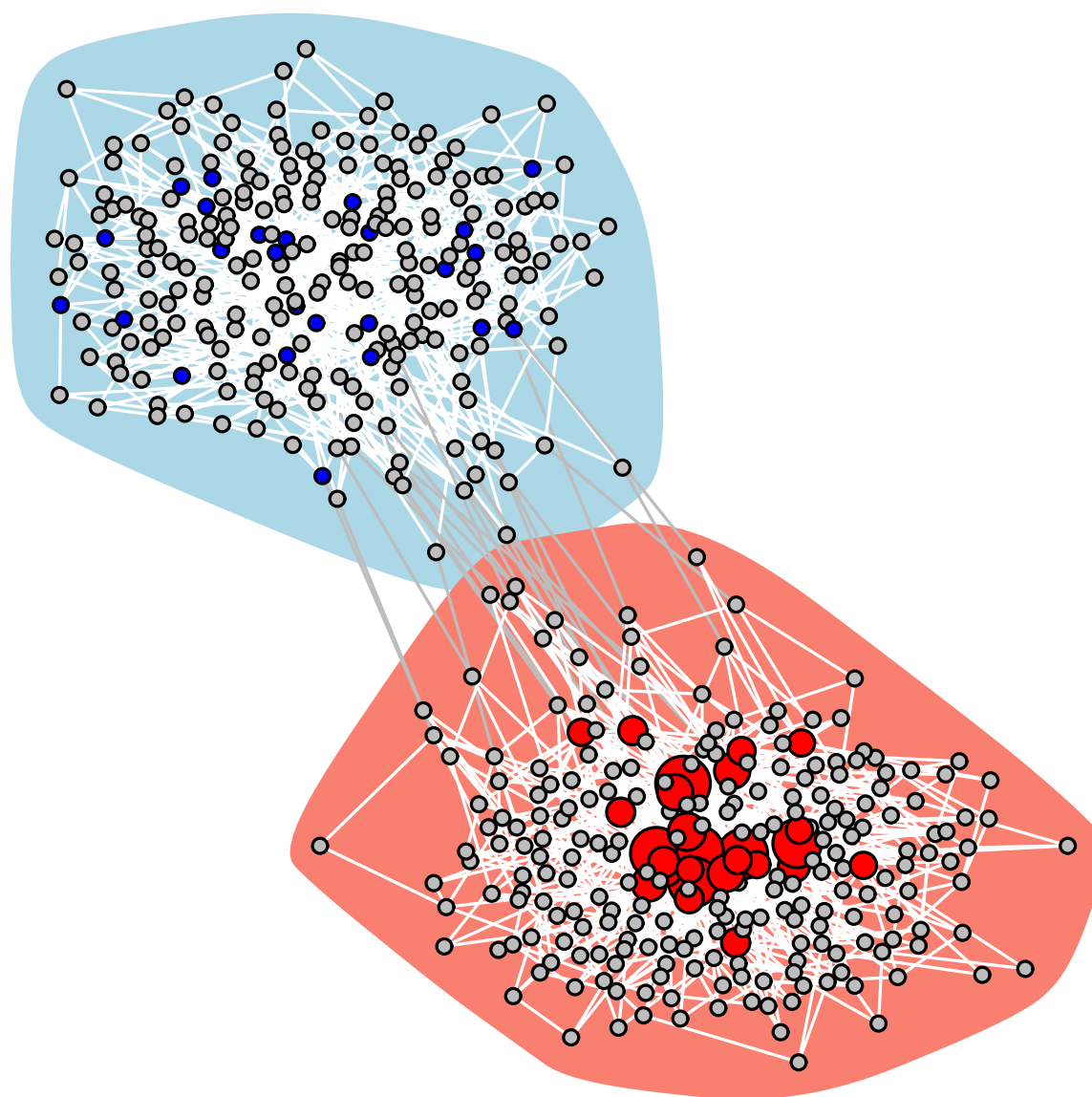
gullible group:

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- **HUBS are eFC!**

Simulation start



Simulation results

Hubs as eternal fact-checkers

Setting

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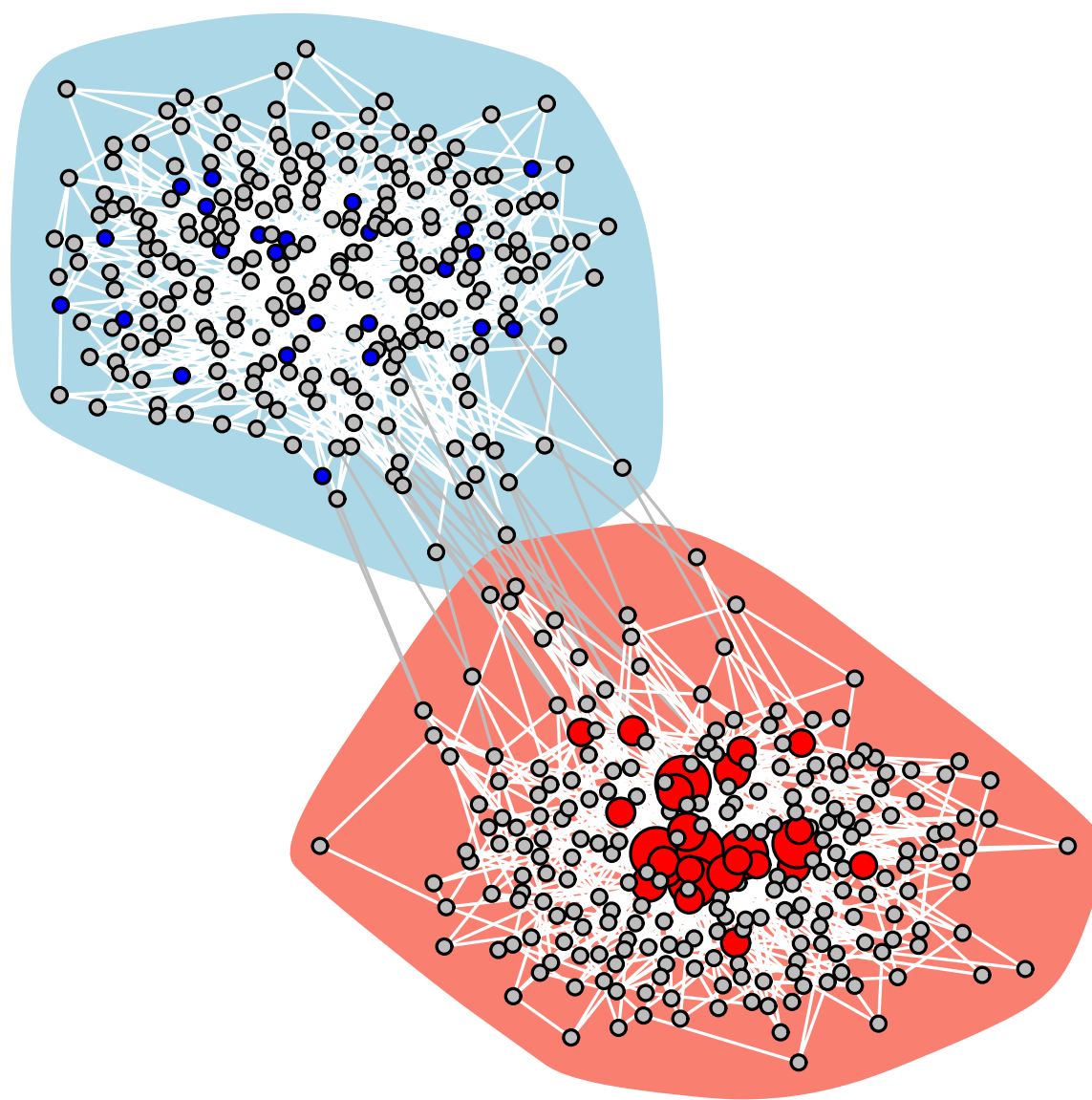
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Simulation results

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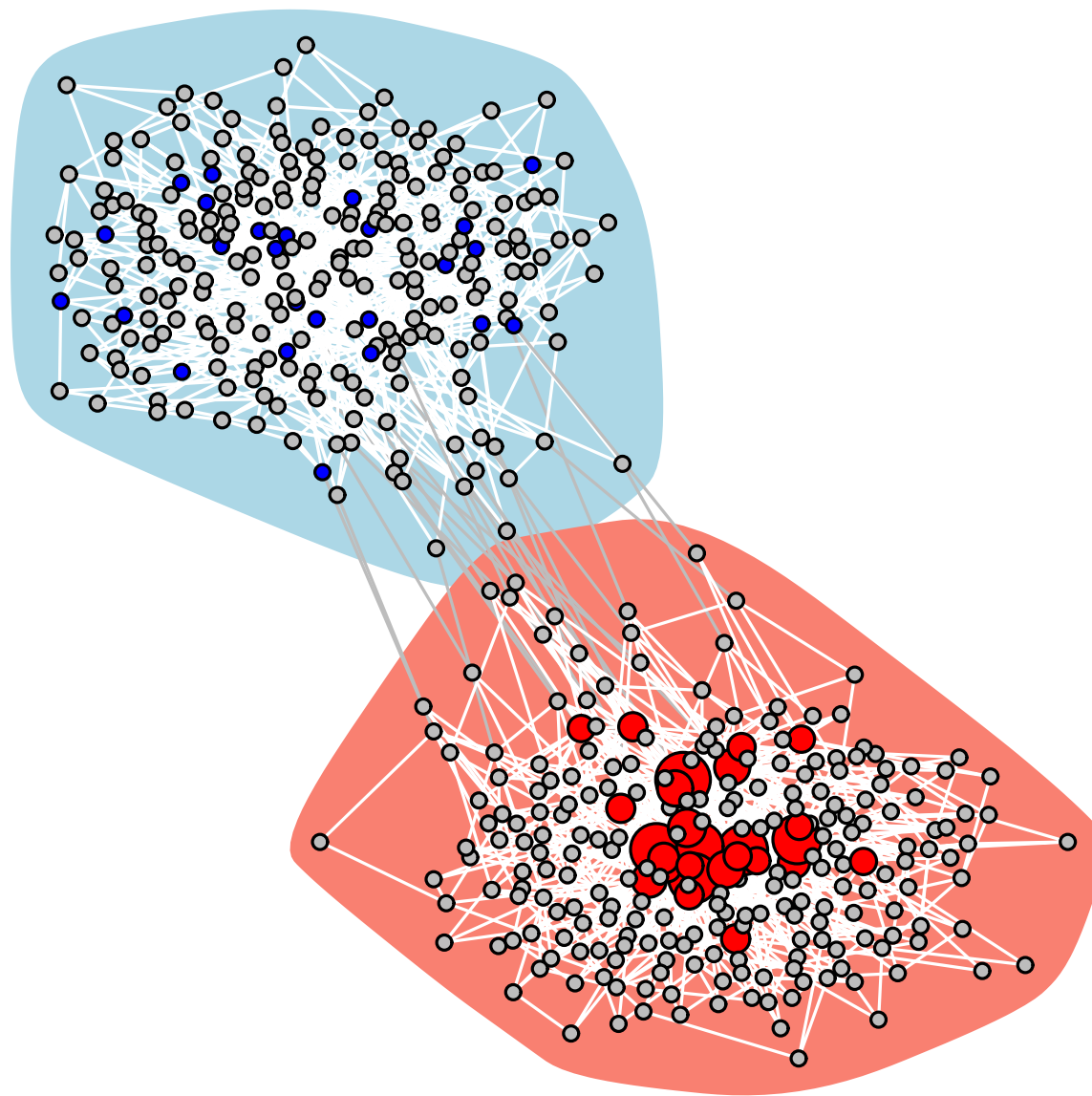
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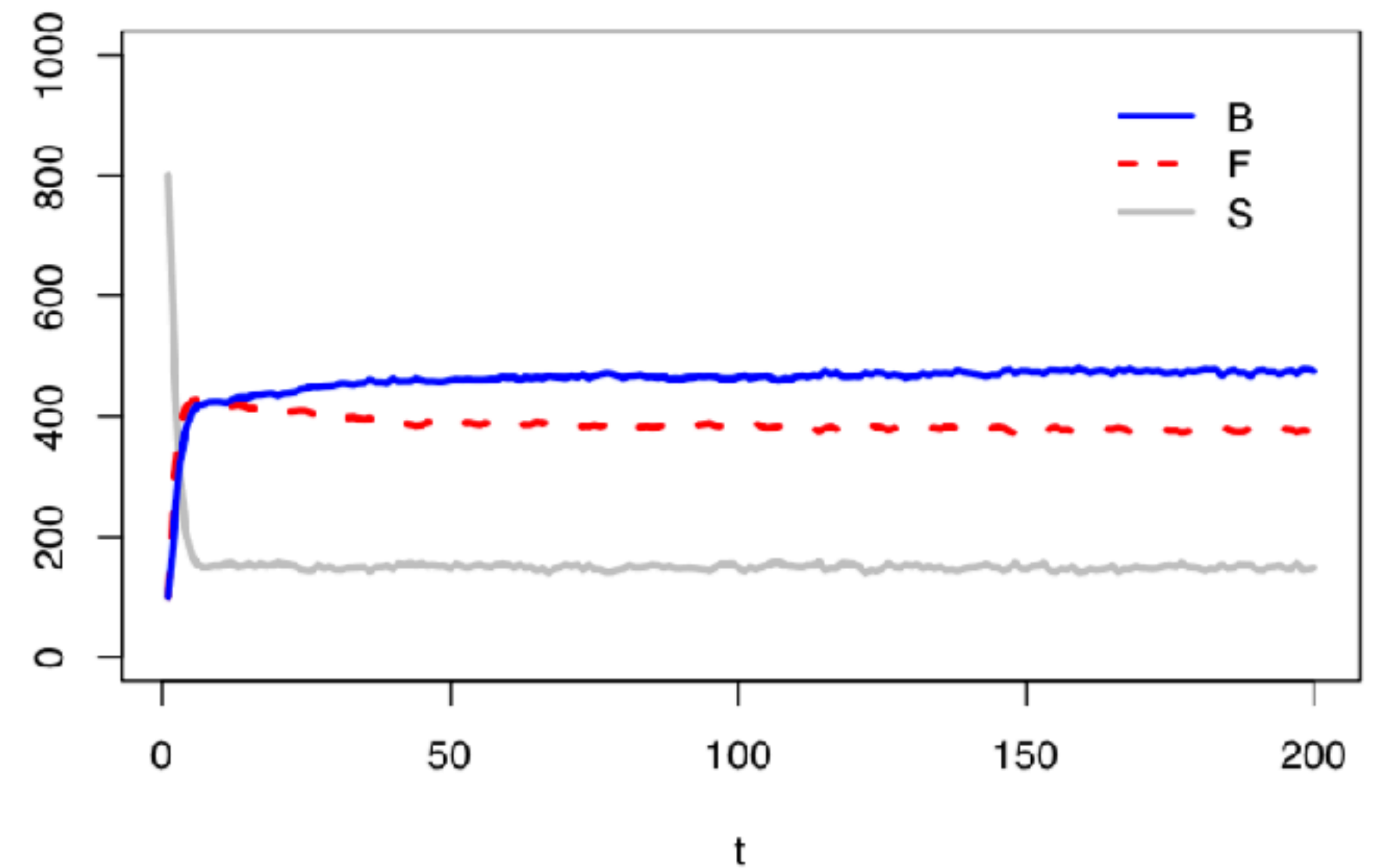
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Simulation results



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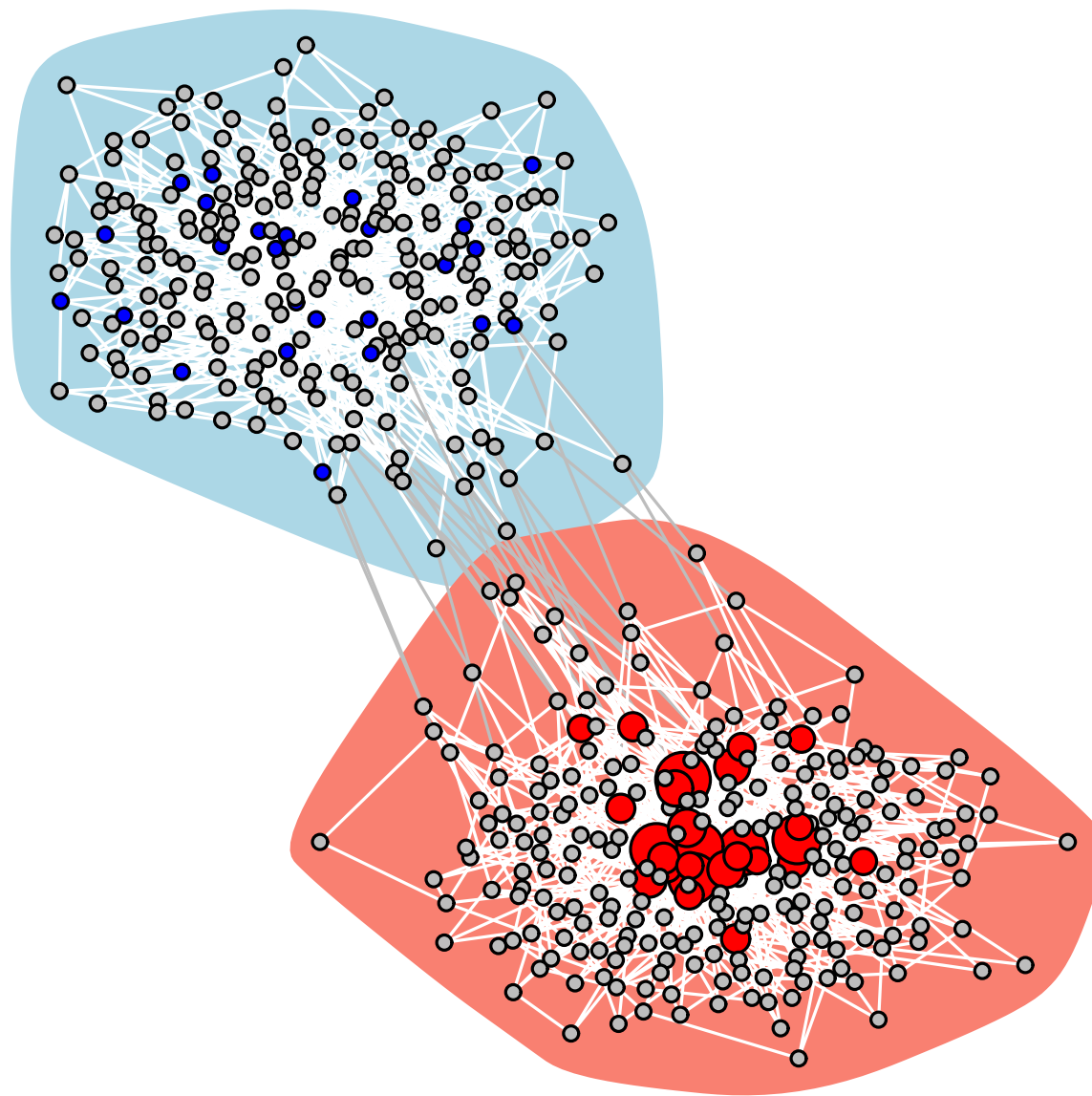
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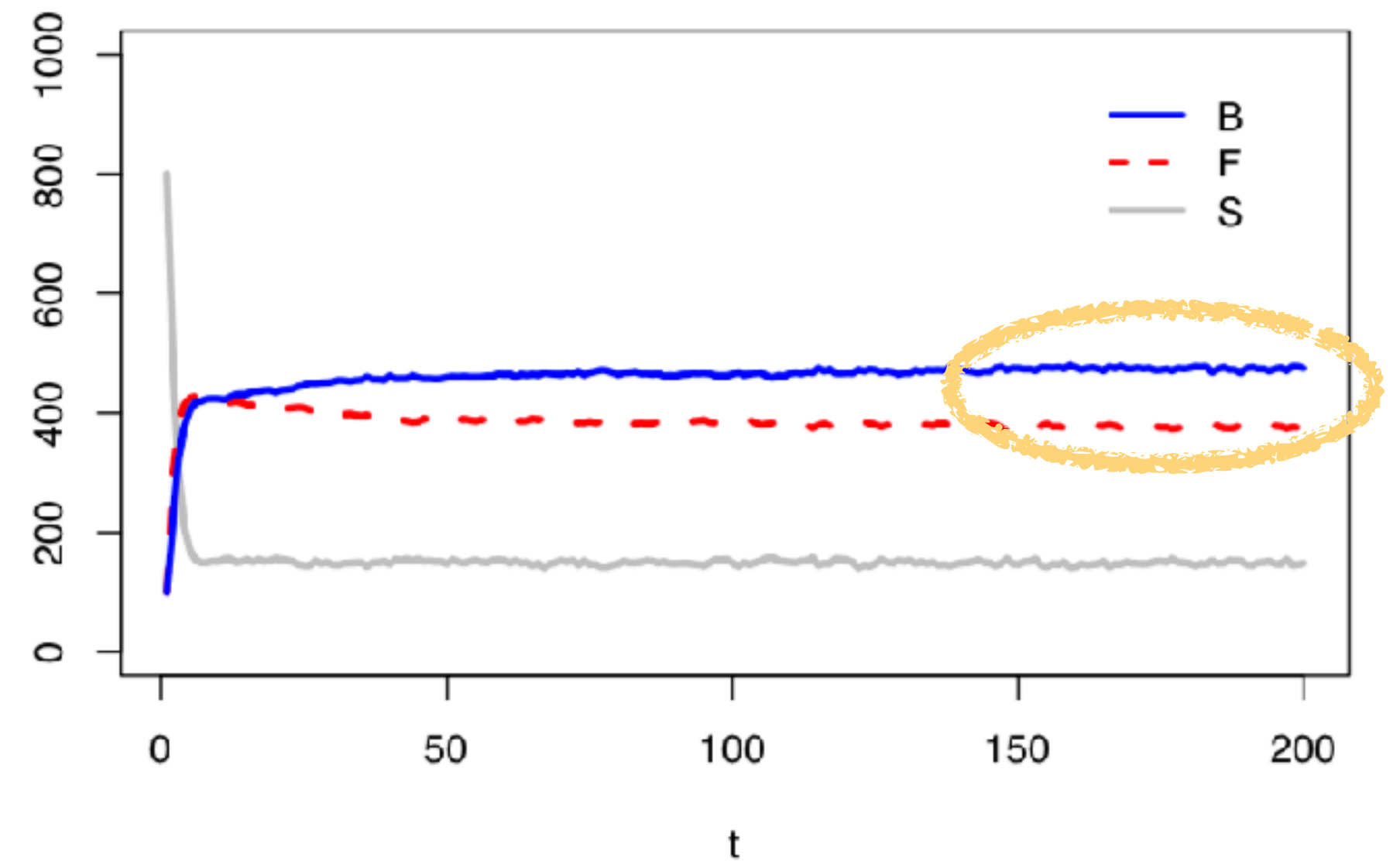
skeptical group:

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Simulation start



Simulation results



better

Bridges as eternal fact-checker

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Simulation start

Simulation results

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Simulation start

Simulation results

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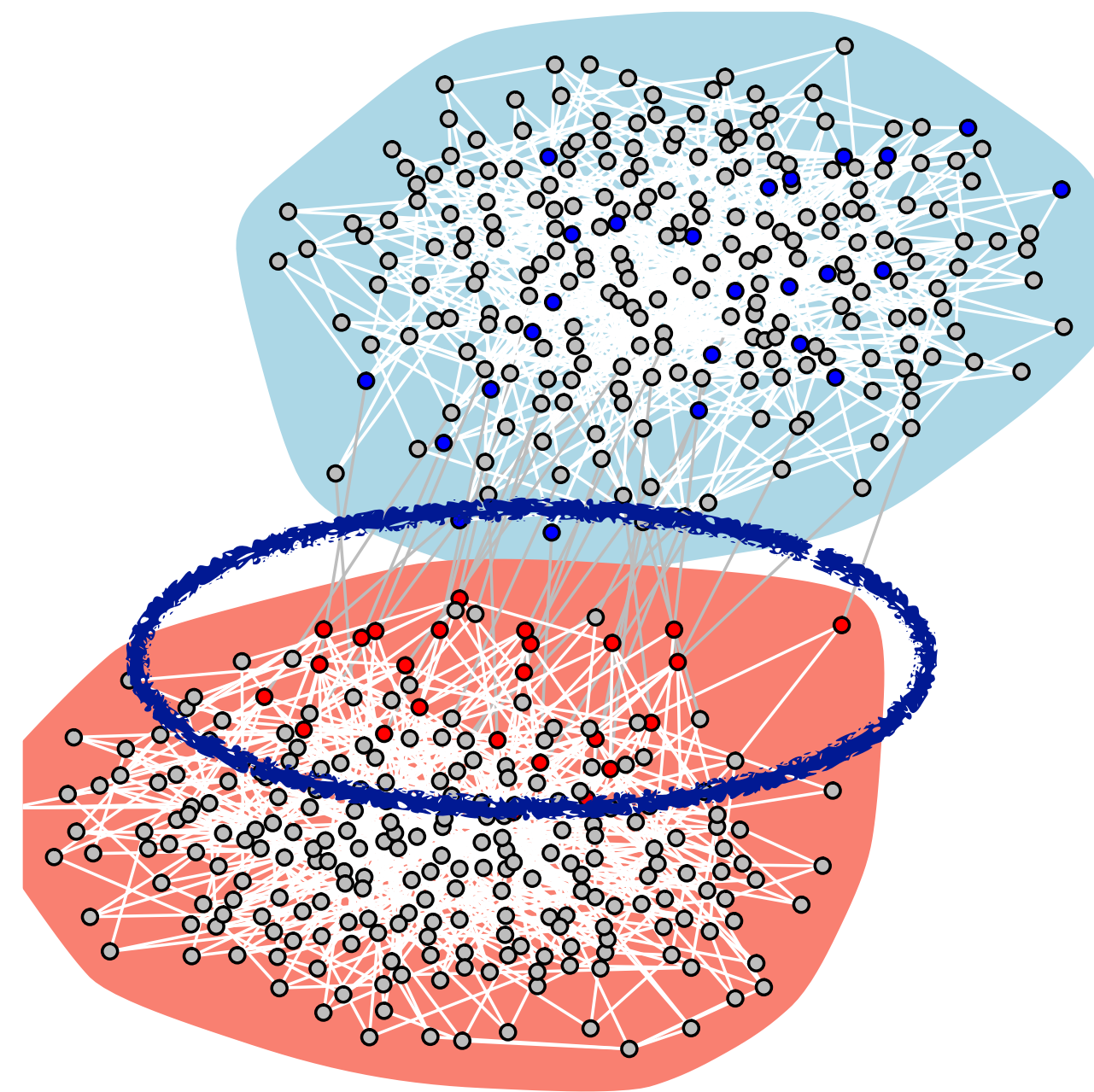
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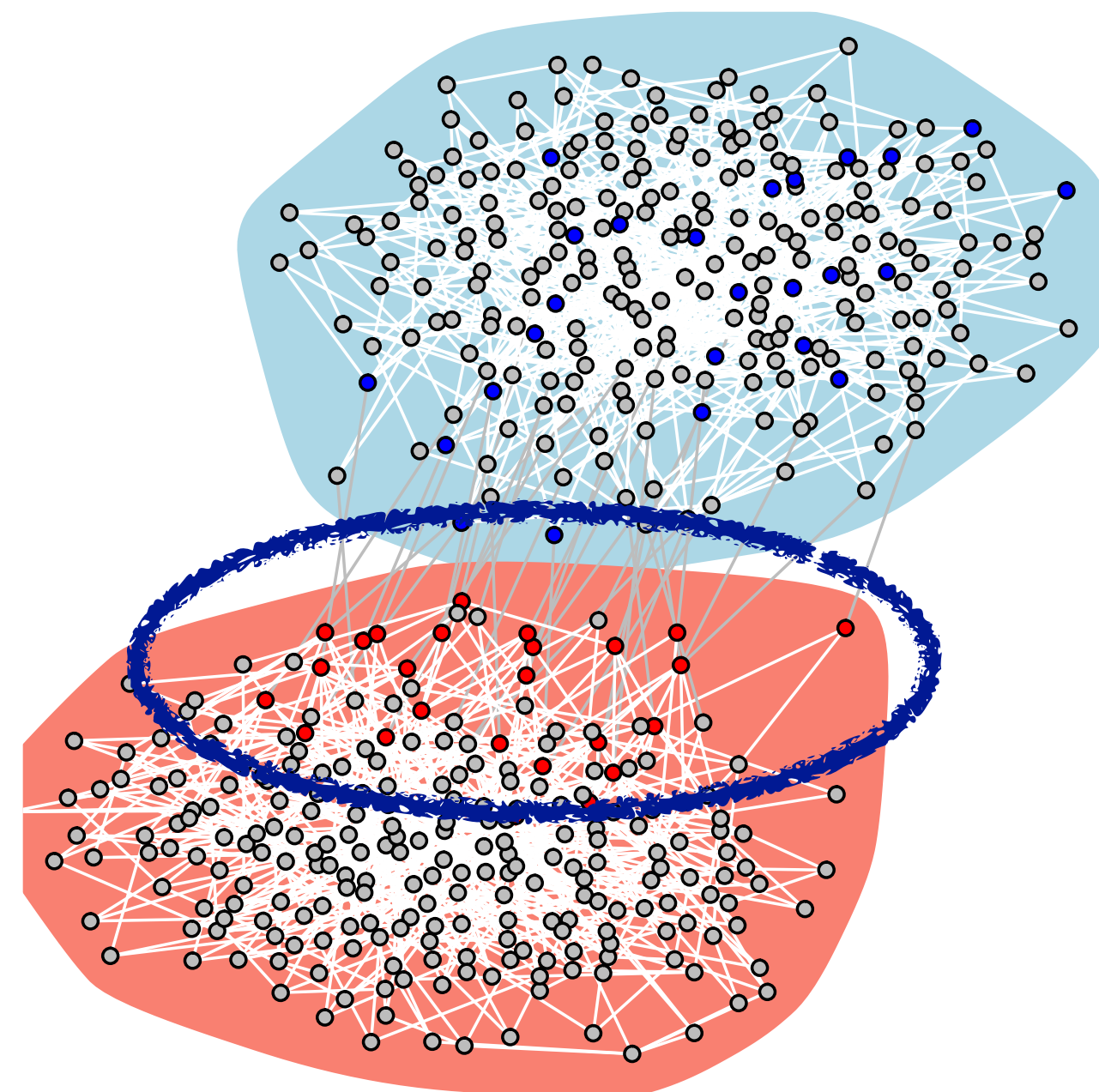
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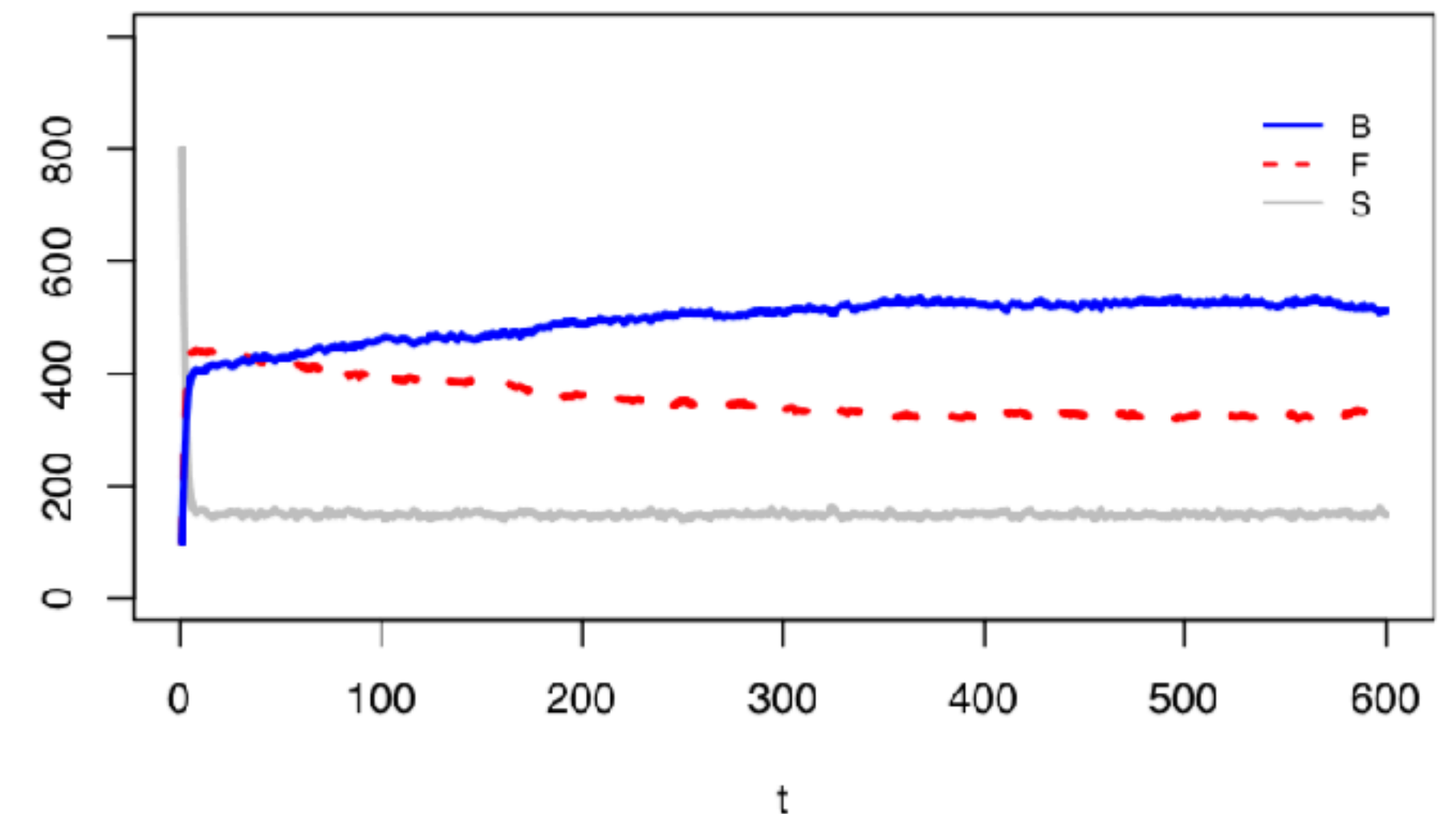
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forgetting: 0.1 (low)

gullible group:

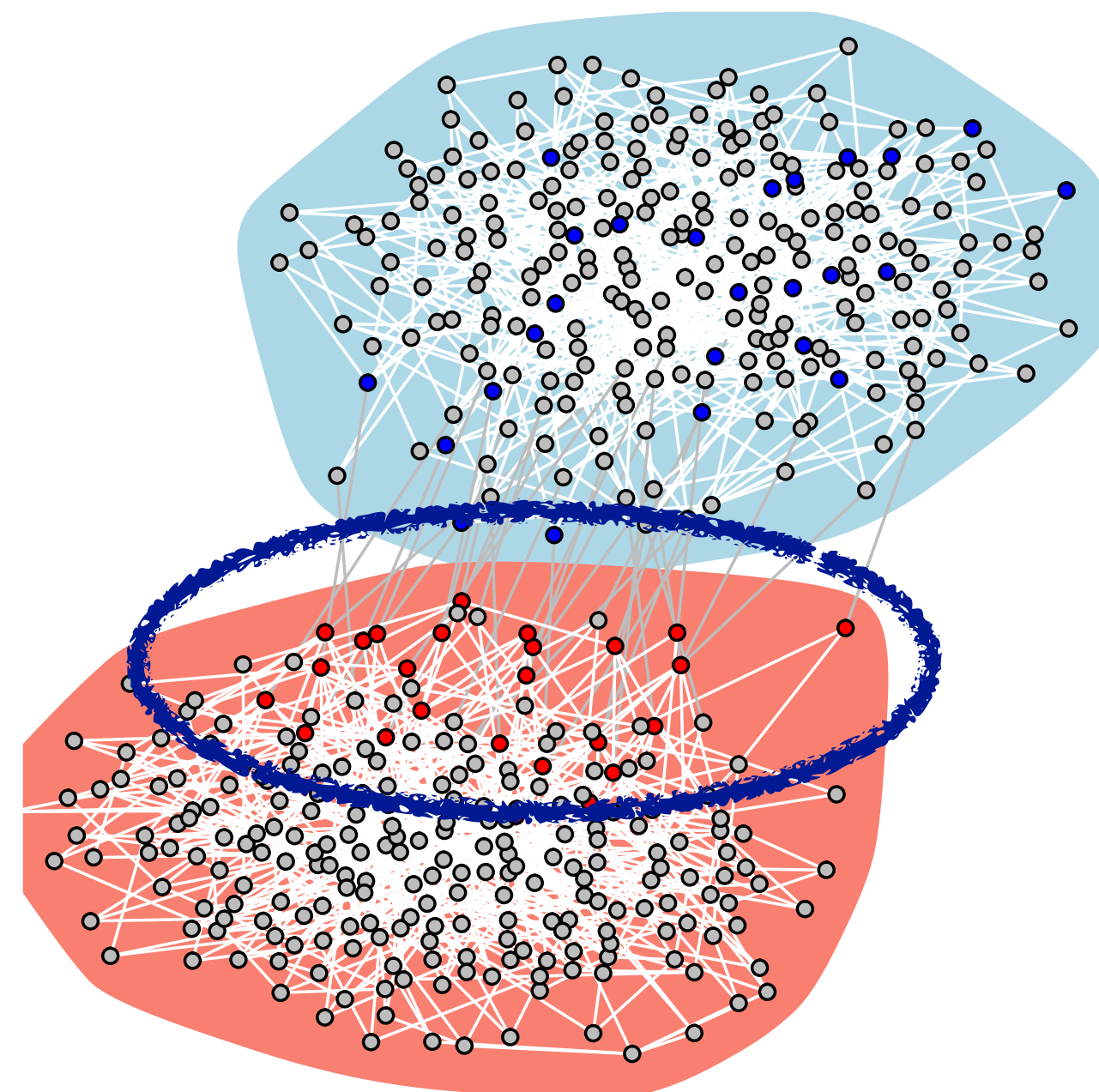
- α : 0.8
- seeders B: 10%

skeptical group:

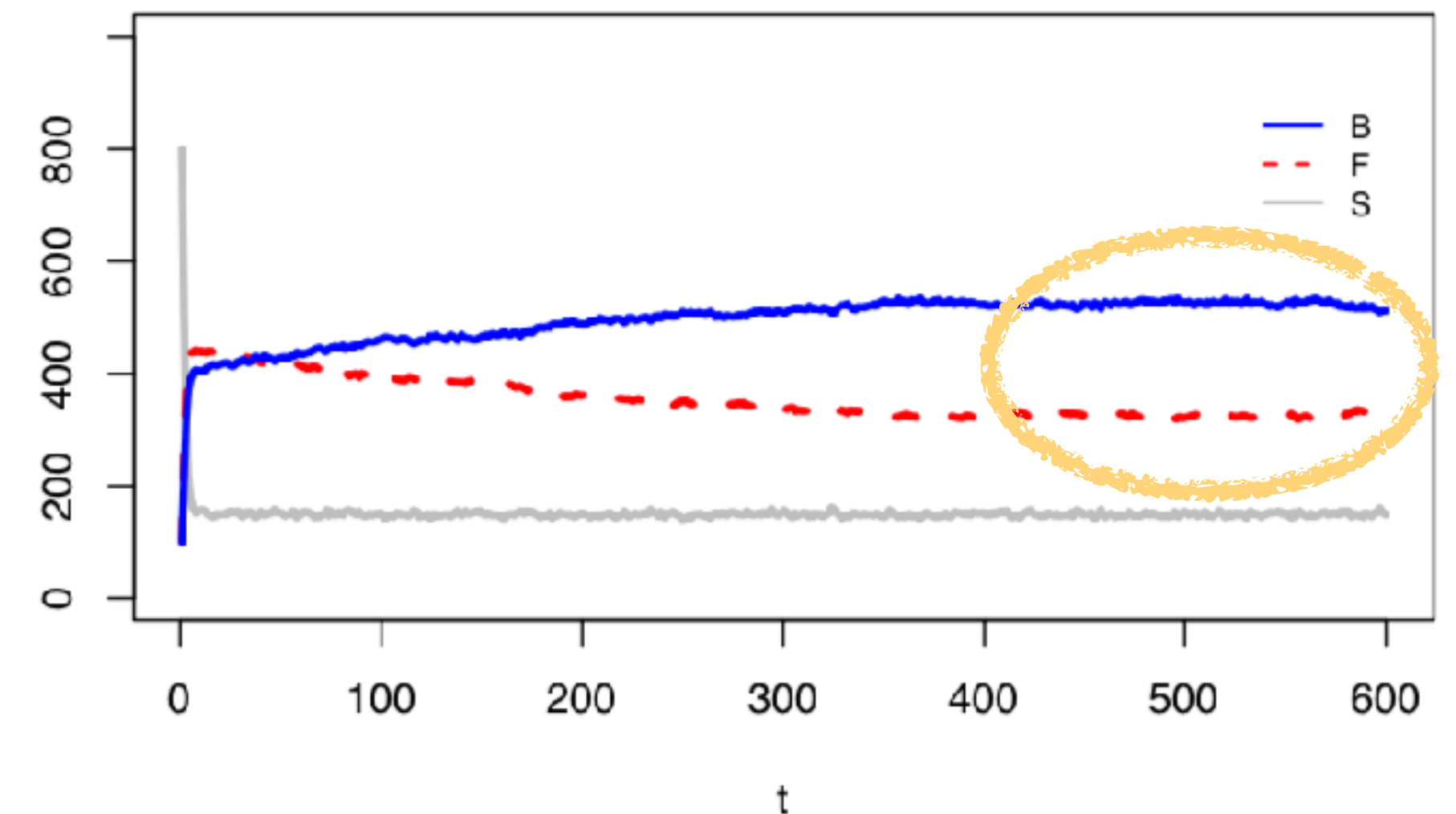
- α : 0.3
- seeders FC: 10%

- **BRIDGES are eFC!**

Simulation start



Simulation results



comparable, more realistic

Lessons learned and observations

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- ❖ Note: no socio-psychological assumption so far. Real world is much more complicated

protect the vulnerable, encourage skepticism

Who is the gatekeeper?

Finland is reported as winning the war against fake news in the classrooms: **education first**

Teachers and the education system have **a great responsibility**

CNN

Twitter Facebook

SPECIAL REPORT

Finland is winning the war on fake news. What it's learned may be crucial to Western democracy

By Eliza Mackintosh, CNN
Video by Edward Kiernan, CNN



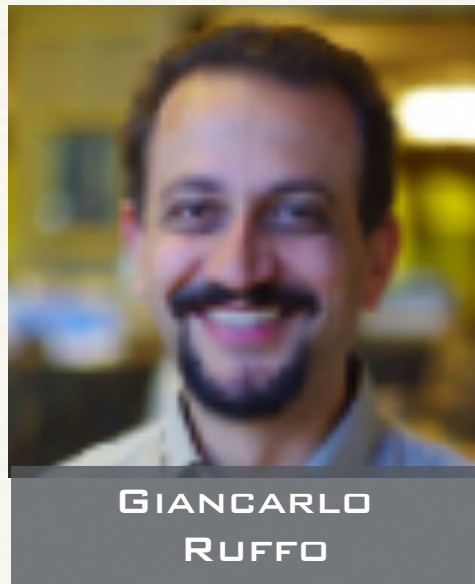
Helsinki, Finland (CNN) - On a recent afternoon in Helsinki, a group of students gathered to hear a lecture on a subject that is far from a staple in most community college curriculums.

Standing in front of the classroom at Espoo Adult Education Centre, Jussi Toivanen worked his way through his PowerPoint presentation. A slide titled "Have you been hit by the Russian troll army?" included a checklist of methods used to deceive readers on social media: image and video manipulations, half-truths, intimidation and false profiles.

Discussion and conclusions

Recap

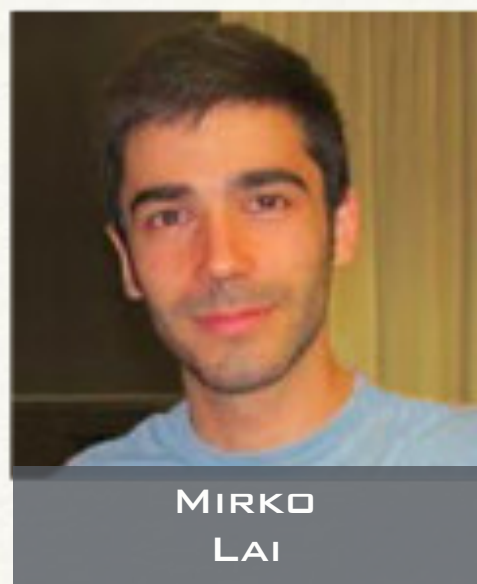
- ❖ **Structural segregation** may be one of the main triggers of opinion **polarization**
- ❖ **Fake-news spreading**, especially when partisanship and antagonistic behavior reinforce the debate, is **facilitated** in segregated networks
- ❖ Fact-checking is needed and skeptics with links to more gullible (vulnerable) contacts can be recruited as **gatekeepers**
- ❖ Beware of the **interplay**: segregation causes polarization and vice-versa



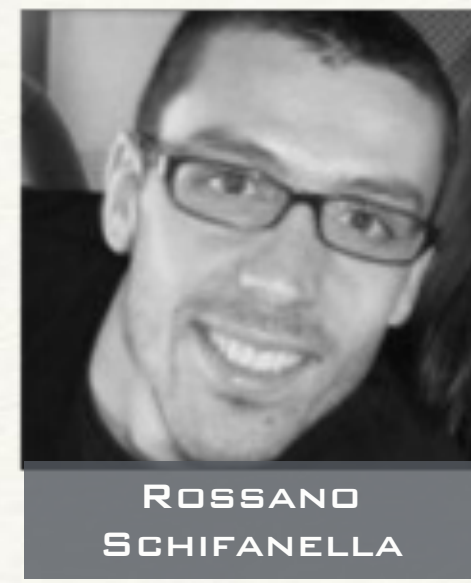
GIANCARLO RUFFO



MARCELLA TAMBUSCIO



MIRKO LAI



ROSSANO SCHIFANELLA



ANDRÉ PANISSON



LUCA AIELLO



VIVIANA PATTI



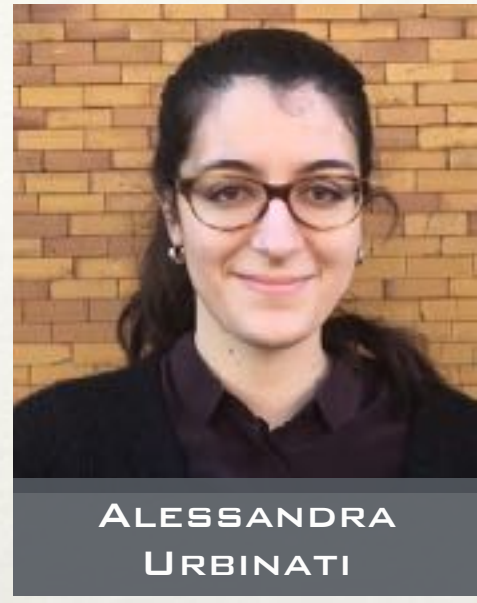
ARTHUR CAPOZZI



EDUARDO GALIMBERTI



ALFONSO SEMERARO



ALESSANDRA URBINATI



SALVATORE VILELLA



EMILIO SULIS



MARTINA DEPLANO



CRISTINA BOSCO

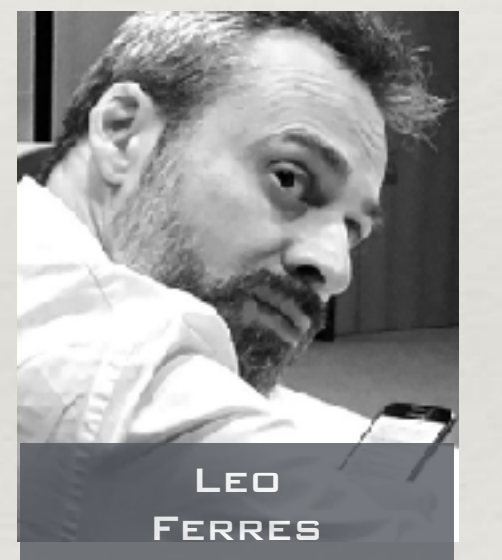
ARC²S: Applied Research on Computational Complex Systems

Thanks!

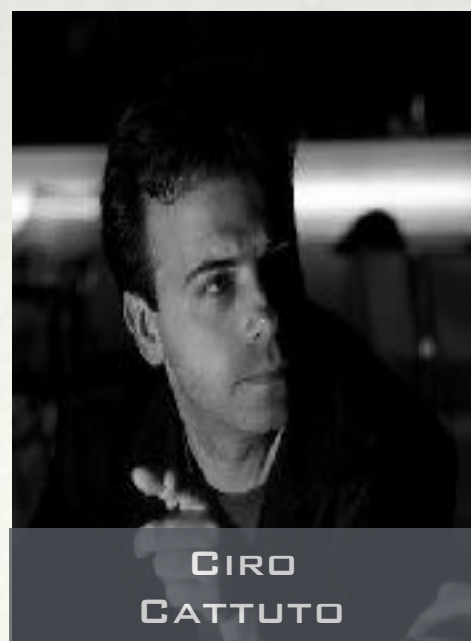
http://www.di.unito.it/~ruffo/talks/2019_Oct_NEU.pdf



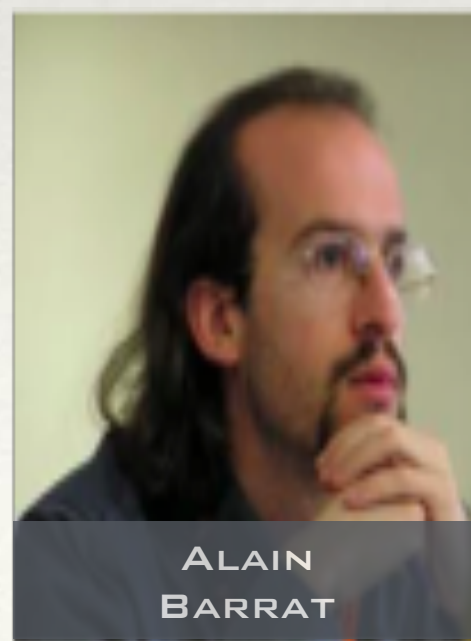
PAOLO ROSSO



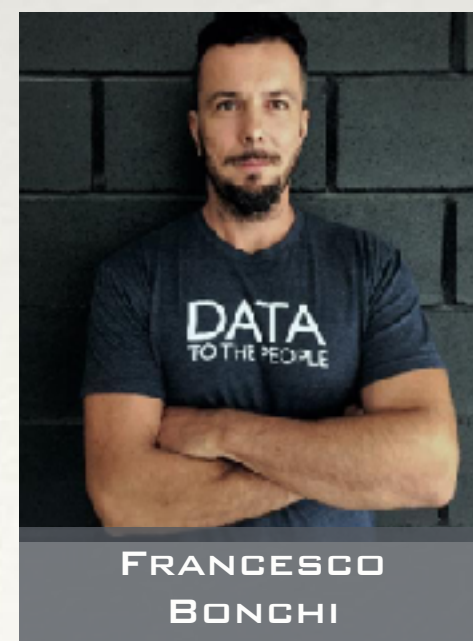
LEO FERRER



CIRO CATTUTO



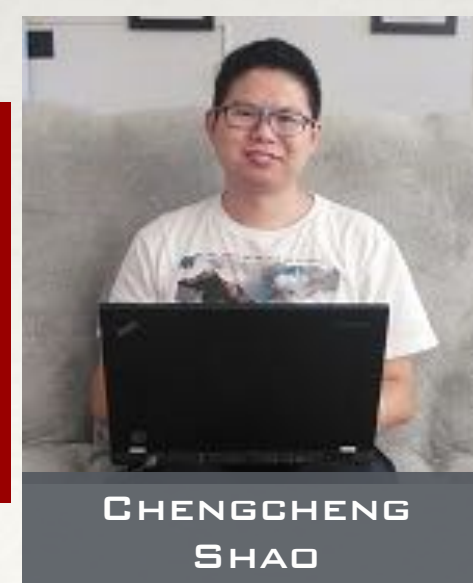
ALAIN BARRAT



FRANCESCO BONCHI



DANIELA PAOLOTTI



CHENGCHENG SHAO



GIOVANNI LUIGI CIAMPAGLIA



ALESSANDRO FLAMMINI



FIL MENCZER