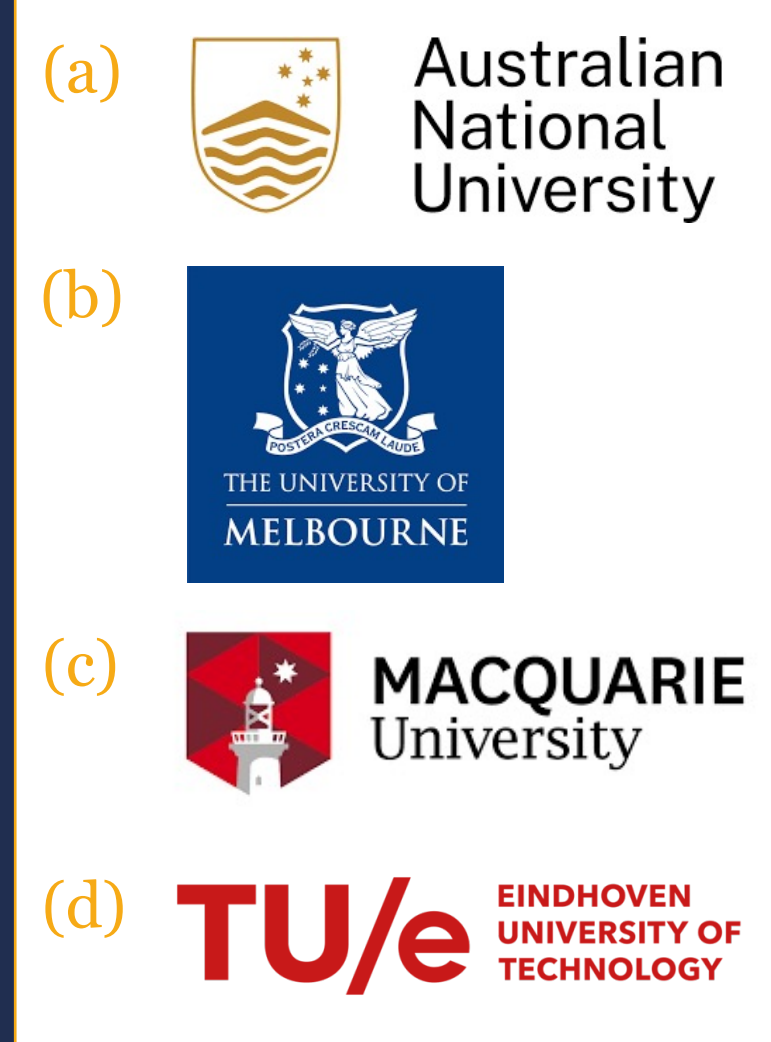


The wisdom of crowds: an efficient, philosophically-validated, social epistemological network profiling toolkit

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Background



- Social epistemology: ‘concerns the testimony of others embedded in social contexts’ [1].
- Social epistemic networks – e.g. retweets on Twitter.
- Consider this problem: ‘gossip heard from two people seems more reliable than from one, but that reliability is undermined if both heard it from the same person’ [2].

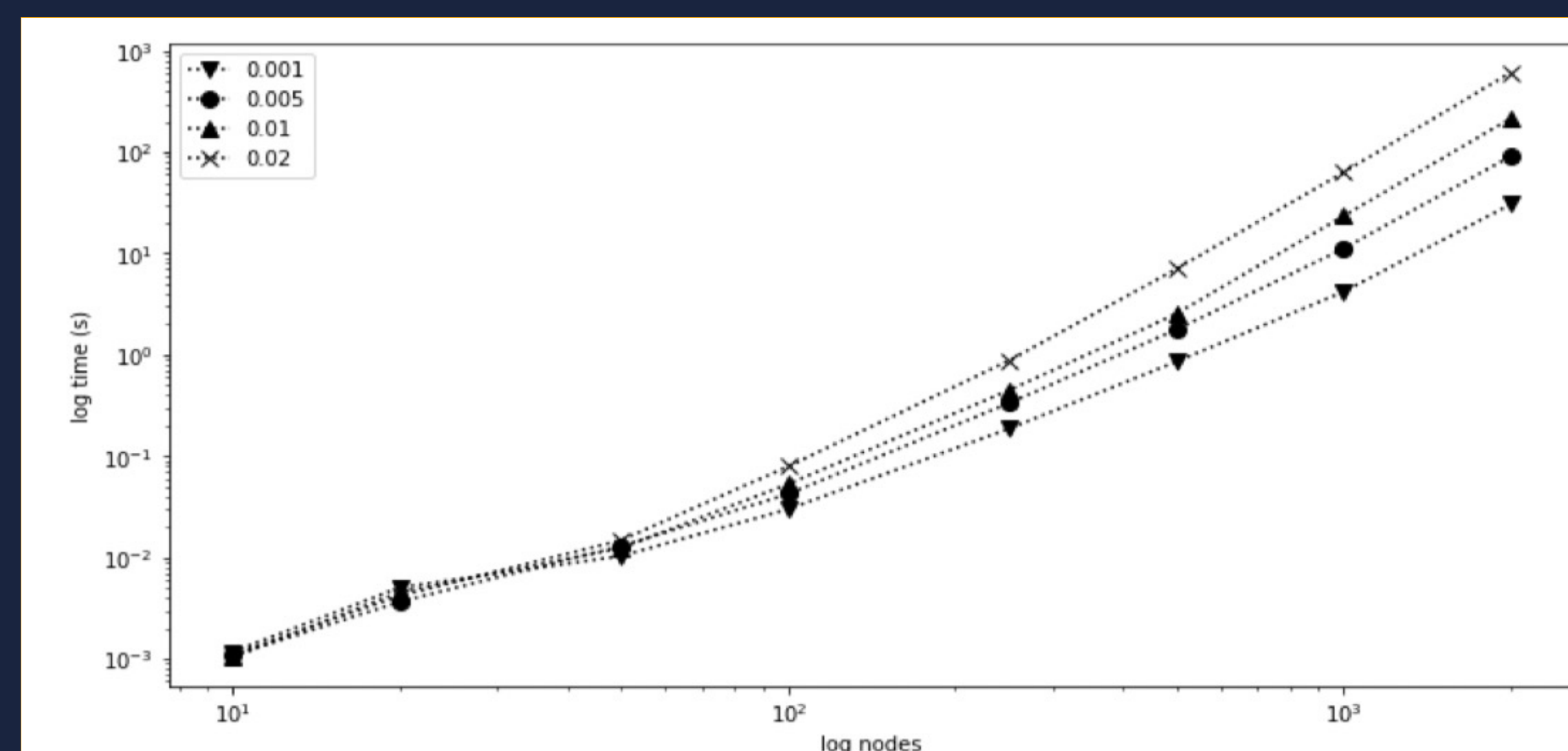
State of the art



- Sullivan et al. [3] devised a method for ‘quantitatively characterizing the epistemic position of individuals in a network’.
- Based on Surowiecki’s [4] Wisdom of Crowds hypothesis.
- Limitation: bespoke, closed-source codebase; scaling up is needed; needs testing on robustness of code.

Our contribution:
an **open source, peer-reviewed**, re-implementation in Python of the core Sullivan et al. [3] concepts; **optimized** to deal with larger networks; built on **existing standards** to support **cross-disciplinary** collaboration.

`pip install wisdom_of_crowds`



Code profiling output: robust up to magnitudes of 10^3 nodes. Empirically tested on $\sim 10^4$ nodes and $\sim 10^5$ edges.

Core concepts [3]



Defining the (m, k)-observer: we say that a node **n** is an **(m, k)-observer** just in case it receives information from a set of at least **k** different nodes which are pairwise at least **m** steps away from one another.

S(n), independence of sources.

S(n) gives a measure of the independence of sources to node **n**.

$$S(n) = \begin{cases} 0 & \text{if } s = \emptyset \\ \max\{mk : (m, k) \in s\} & \text{otherwise} \end{cases}$$

D(n), diversity of sources.

D(n) gives the number of distinct types of information that feed into **n**.

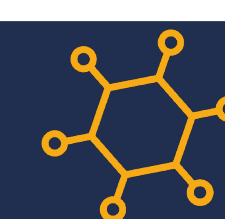
$$D(n) = |\bigcup \{a_i : i \in s\}|$$

$\pi(n)$, epistemic position.

The epistemic position of a node is a function of both the diversity and independence of sources.

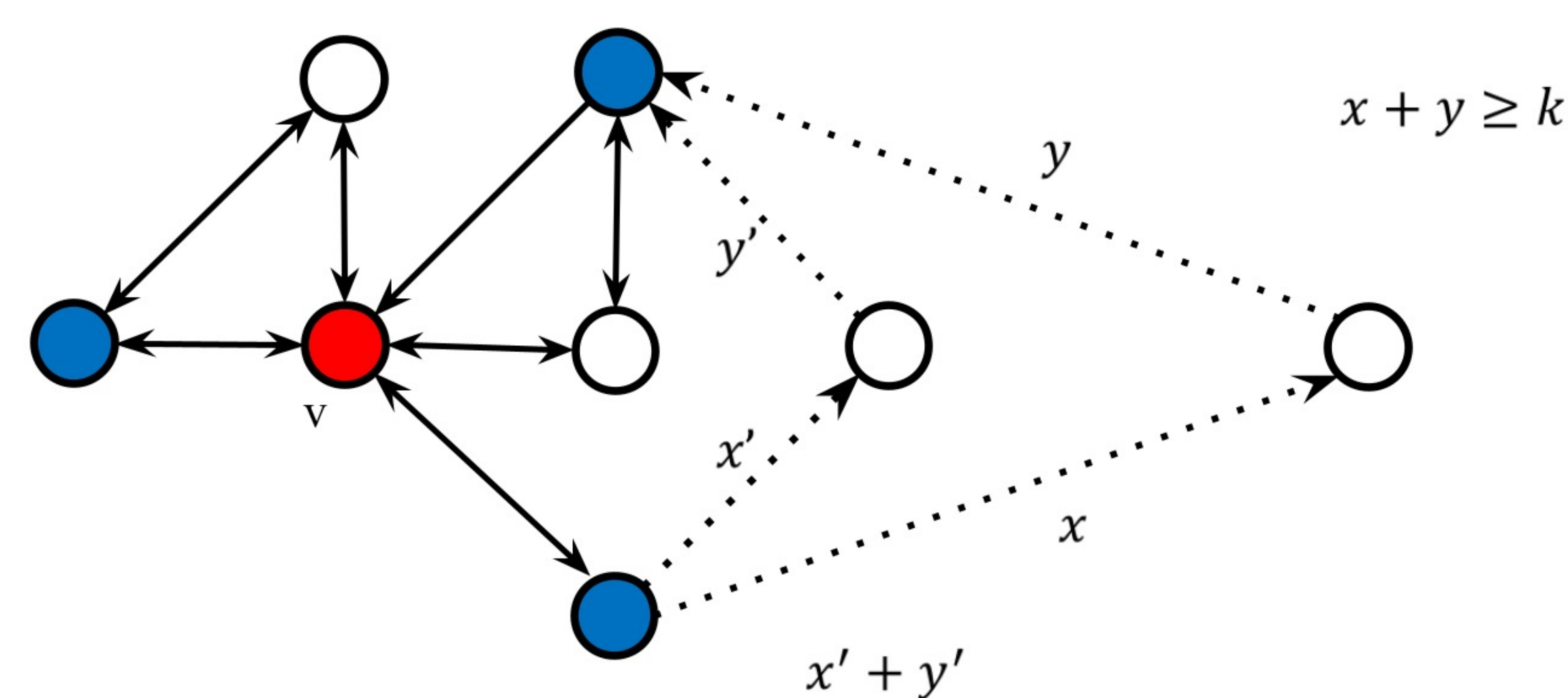
$$\pi(n) = S(n)D(n)$$

Worked example [3]



v is an **(m, k)-observer** in structure **S** if and only if

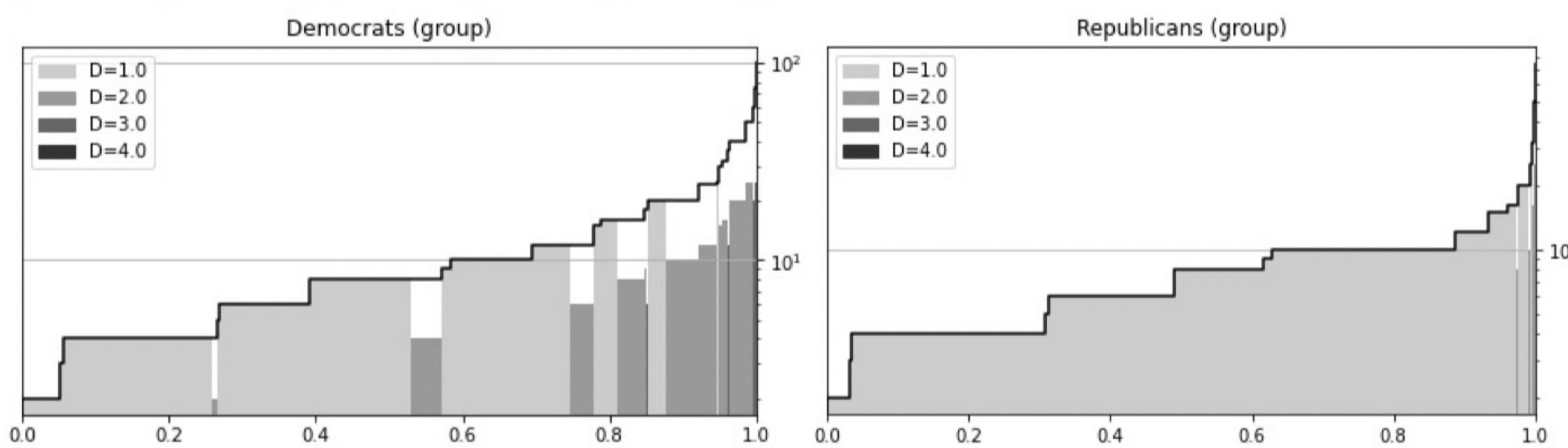
- There are **m** vertices in **S** with an edge to **v**, and
- Every **xy-path** with length $< k$ contains **v**



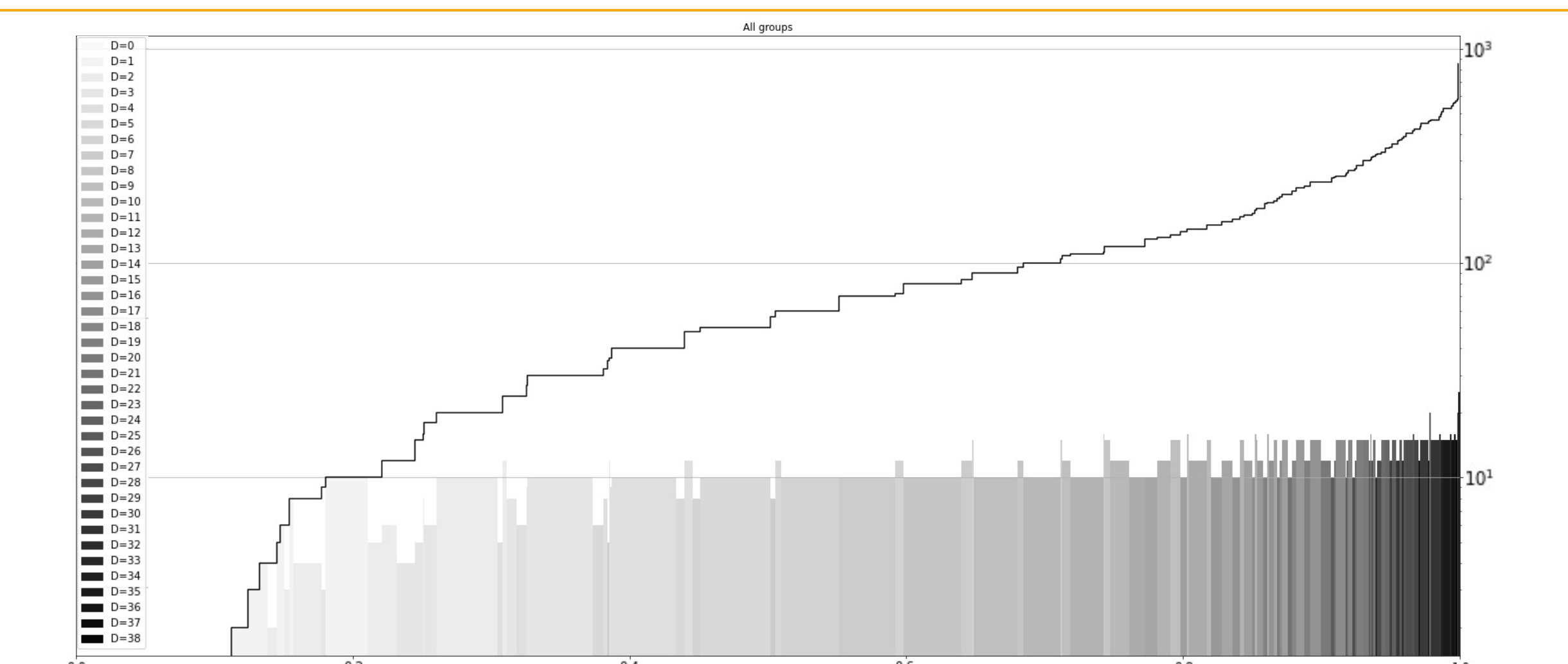
Hence, **v** is a (3,2)-observer.

Imagine structure **S** as a Twitter retweet network, with each node (@user) having a diverse set of views (e.g. ‘for’ and ‘against’).

Applications



Information-sharing dynamics during the **Black Lives Matter** movement on **Twitter**. Republicans are a monoculture socially (low $D(n)$), compared to Democrats (evidence of higher $D(n)$ values).



email-Eu-core network of European researchers: researchers with contacts from a more diverse range of disciplines have higher $D(n)$ to optimise overall π .

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1. Goldman, A. I. (1999). Knowledge in a social world. Oxford University Press
2. Alfano, M. and Robinson, B. (2017). Gossip as a burdened virtue. *Ethical Theory and Moral Practice*, 20(3):473–487
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