Universität Zürich[UZH]

UZH Blockchain Center

Blockchain & DLT Research Group

Network Science HS24

Assignment 2

Blockchain & Distributed Ledger Technologies Group

FOR STUDIES PURPOSES ONLY

UZH Blockchain Center
Faculty of Business, Economics and Informatics
University of Zurich
Zurich, September 30, 2024

Average Nearest Neighbour Degree (6 points)

For the provided datasets (you can find the dataset files on OLAT):

1. (1 point) Plot a scatter plot with the average degree of the nearest neighbours $k_{nn}(k)$ against the degree.
2. (1 point) Plot the same scatter plot from question 1 but using a randomised version of the network. Plot the distribution in the same figure together with the scatter plot you obtained in question 1.

   Hint: The randomised networks are obtained via multiple edge swaps via the `networkx` function: `nx.algorithms.smallworld.random_reference`. Make sure to set the parameter `connectivity = False` to have faster execution.
3. (1 point) Compute the assortativity coefficient of the real network and the randomized network. Put the computed assortativity values in the plot labels of the figure you created in question 2.
4. (1 point) Plot the probability density of degree values $p(k) = \mathbb{P}(k_i = k) \in [0, 1] \, \forall i \in V$. Use a logarithmic binning and adjust the axis scales accordingly. *Hint: look into `plt.hist()` documentation*
5. (1 point) For each network, provide a short comment on the plots you produced in the previous 4 questions. Decide whether a Network is assortative or disassortative. Explain your rationale.
6. (1 point) Find a dataset representing a disassortative or assortative network. Provide a clear description of the network's origin and nature, and explain why your network would exhibit assortative/disassortative behavior (Support your claim by repeating the task you performed for question 1-5).

Datasets Provided

- C. elegans interactomes: Nodes represent proteins and Edges represent protein-protein interactions in Caenorhabditis elegans (nematode), Simonis and et al. [2009].
- AstroPhysics Arxiv collaborations: Nodes represent authors of papers submitted to arxiv.org in the AstroPh category and Edges represent co-authorship between two authors, Leskovec et al. [2007].
- Kaggle chess players: Nodes represent chess players and Edges represent chess match among the world's top chess players, *Chess ratings - Elo versus the Rest of the World* [2010].
- European airline network: Nodes represent airlines and Edges represent airline routes among European airports, Cardillo et al. [2013].
- Game of Thrones co-appearances: Nodes represent Game of Thrones characters and Edges represent co-appearances of characters in the Game of Thrones series, Beveridge and Shan [2016].
- Internet AS graph: Nodes represent autonomous systems and Edges represent connections between them, Karrer et al. [2014].
- Jazz collaboration network: Nodes represent jazz musicians and Edges represent collaborations in bands that performed between 1912 and 1940, Gleiser and Danon [2003].

References

Beveridge, A. and Shan, J. [2016]. Network of thrones, *Math Horizons* **23**(4): 18–22.

Cardillo, A., Gómez-Gardenes, J., Zanin, M., Romance, M., Papo, D., del Pozo, F. and Boccaletti, S. [2013]. Emergence of network features from multiplexity, *Scientific Reports* **3**: Article number: 1344.

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