Open Access

Rumor Spreading and Degree-Related Preference Mechanism on a Small-World Network

Author(s)

Zhi Zhu, Fengjian Liu, Dongsheng Liao

ABSTRACT

An alternate model for rumor spreading over small-world networks is suggested, of which two rumors (termed rumor 1 and rumor 2) have different nodes and probabilities of acceptance. The propagation is not symmetric in the sense that when deciding which rumor to adopt, high-degree nodes always consider rumor 1 first, and low-degree nodes always consider rumor 2 first. The model is a natural generalization of the well-known epidemic SIS model and reduces to it when some of the parameters of this model are zero. We find that rumor 1 (preferred by high-degree nodes) is dominant in the network when the degree of nodes is high enough and/or when the network contains large clustered groups of nodes, expelling rumor 2. However, numerical simulations on synthetic networks show that it is possible for rumor 2 to occupy a nonzero fraction of the nodes in many cases as well. Specifically, in the NW small-world model a moderate level of clustering supports its adoption, while increasing randomness reduces it.

KEYWORDS

Rumor; Degree-Related Preference Mechanism; Small-World Network

Cite this paper

References

[1]   Cane, V. R. (1966). A note on the size of epidemics and the number of people hearing a rumour. J. R. Stat. Soc. Ser. B, 28, 487-490.

[2]   Chakrabarti, D., Wang, Y., Wang, C., Leskovec, J., & Faloutsos, C. (2008). Epidemic thresholds in real networks. ACM Transactions on Information and System Security, 10, 1-26. doi:10.1145/1284680.1284681

[3]   Christley, R. M. et al. (2005). Infection in social networks: Using network analysis to identify high-risk individuals. American Journal of Epidemiology, 162, 1024-1031. doi:10.1093/aje/kwi308

[4]   Daley, D. J., & Kendall, D. G. (1964). Epidemics and rumours. Nature, 204, 1118. doi:10.1038/2041118a0

[5]   Daley, D. J., & Kendall, D. G. (1965). Stochastic rumours. Journal of Applied Mathematics, 1, 42-55. doi:10.1093/imamat/1.1.42

[6]   Draief, M., Ganesh, A., & Massoulie, L. (2008). Thresholds for virus spread on networks. Annals of Applied Probability, 18, 359-378. doi:10.1214/07-AAP470

[7]   Goldenberg, J., Libai, B., Moldovan, S., & Muller, E. (2007). The NPV of bad news. International Journal of Research in Marking, 24, 186-200. doi:10.1016/j.ijresmar.2007.02.003

[8]   Granovetter, M. (1978). Threshold models of collective behavior. American Journal of Sociology, 83, 1420-1443. doi:10.1086/226707

[9]   Guardiola, X., Diaz-Guilera, A., Perez, C. J., Arenas, A., & Llas, M. (2002). Modeling diffusion of

innovations in a social network. *Physical Review E, 66*, Article ID: 026121. doi:10.1103/PhysRevE.66.026121

[10] Kempe, D., Kleinberg, J., & Tardos, E. (2003). Maximizing the spread of influence in a social network. *Proceeding of the 9th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining* (pp. 137-146). New York: ACM Press. doi:10.1145/956750.956769

[11] Landahl, H. D. (1953). On the spread of information with time and distance. *Bulletin of Mathematical Biology, 15*, 367-381. doi:10.1007/BF02476410

[12] Liu, Y. H. et al. (2011). Rumor riding: Anonymizing unstructured peer-to-peer systems. *IEEE Transactions on Parallel and Distributed Systems, 22*, 464-475. doi:10.1109/TPDS.2010.98

[13] Newman, M. J., Watts, D. J. (1999). Renormalization group analysis of the small-world network model. *Physics Letters A, 263*, 341-346. doi:10.1016/S0375-9601(99)00757-4

[14] Rapoport, A., & Rebhun, L. I. (1952). On the mathematical theory of rumor spread. *Bulletin of Mathematical Biology, 14*, 375-383. doi:10.1007/BF02477853

[15] Sudbury, A. (1985). The proportion of the population never hearing a rumour. *Journal of Applied Probability, 22*, 443-446. doi:10.2307/3213787

[16] Trpevski, D. (2010). Model for rumor spreading over networks. *Physical Review E, 81*, Article ID: 056102. doi:10.1103/PhysRevE.81.056102

[17] Watson, R. (1987). On the size of a rumour. *Stochastic Processes and Their Applications, 1*, 141-149. doi:10.1016/0304-4149(87)90010-X