Rumors and misinformation are not the same concepts, although sometimes they mean the same thing in papers. It is widely believed that rumor is unverified information that the spreader may not intend to spread, and misinformation is deliberately fabricated false information that is intentionally spread. But what they have in common is they can harm cyberspace and affect people's real life. For example, [1] observed that people become lazy to think and less sensitive to misinformation. They also investigated behavioral changes of Twitter users after exposure to or replying to misinformation and found that users will post more tweets that contain fewer emotional words and more swear words and conflict-related words. And negative emotions, causal arguments, and threats to core values will make the information more viral[2, 3], thus forming a vicious circle.

Existing research mainly focuses on the characteristics and identification of the rumor[4–7], the source detection of the rumor[8–11], and the spread prediction of the rumor[7]. In fact, the spread of rumors and misinformation is no different from the spread of normal information, except that rumors and misinformation are usually designed to be more viral and spread faster and farther.

First of all, we need to identify and locate rumors and misinformation. Natural language processing techniques[6] and deep learning models[12, 13] are usually good tools[14]. [15] learned word embeddings of rumors and used a recurrent neural network to automatically identify rumors. [12] used Bidirectional long-short term memory(Bi-LSTM) and Graph Convolutional Network(GCN) for text representation learning, and then used attention mechanism to fuse features and get richer knowledge about the text content of rumors, finally used a softmax classifier to predict the truthfulness label of news, i.e., identify rumors. They also introduced topic distribution, context information, and author information of news to help improve the detection performance for short-text fake news. [16] measured the topic-specific credibility of news, socio-cognitive biases of users, and partisan bias of news sources and used the multi-head co-attention mechanism to detect fake news, while achieving good performance. [9] used neighborhood entropy to locate multiple sources of rumors. The neighborhood entropy includes the infection adjacency entropy and the infection intensity entropy, according to whether the neighbor nodes are infected or not.

Then there is the mechanism for the spread of rumors and misinformation. [17] proposed that rumors and misinformation spread faster and more broadly than true information. And rumors and misinformation usually are more novel to attract people to read and spread. Surprisingly, the bots were equally capable of spreading true and false information, implying that humans are responsible for making rumors and misinformation more viral. [18, 19] discovered personality effect and age effect in rumor spreading: more conservative and older people were more likely to spread rumors. In fact, only 6% of news was related to rumors and misinformation, but it was highly focused: only 1% of users were exposed to 80% of rumors and misinformation, and an even smaller proportion of users (0.1%) were sharing 80% of rumors and misinformation. [20] found out that the spreading mechanisms of true and fake news are very similar. The spreading structural difference between true and fake

news is very small and can be simply explained as the difference in the contagiousness of the information, i.e., fake news is more contagious and spread quickly. Therefore, if the cascade size is controlled, we can use a general model to explain both true and fake news spreading. [21] proposed a complex dynamic model of rumor spreading, using a mathematical model to simulate rumor spreading. [22] extracted the users' historical behavior as features and used some state-of-the-art technologies, including Bidirectional Encoder Representation from Transformers(BERT), Cuckoo Search (ICS) method, and temporal convolutional network to predict the trend of rumor spreading.

The control of rumors and misinformation is not simply deleting them, banning malicious users, and providing corrective information. For example, corrective information about diseases and vaccines can be counterproductive to people's perceptions[23]. It may be more appropriate to start with influential elite users and make sure that what they post is not rumor and misinformation, then encourage them to promote correct information[24]. In addition, understanding people's intentions to spread (intentionally or not) can also help us control the spread of rumors and misinformaiton[25].

References

[1] Yichen Wang et al. “Do Twitter users change their behavior after exposure to misinformation? An in-depth analysis”. In: *Social Network Analysis and Mining* 12.1 (Dec. 2022), pp. 1–16. ISSN: 1869-5450. DOI: 10.1007/S13278-022-00992-8/FIGURES/18. URL: https://link.springer.com/article/10.1007/s13278-022-00992-8.

[2] Maryam Mousavi et al. “Effective Messaging on Social Media: What Makes Online Content Go Viral?” In: *Proceedings of the ACM Web Conference 2022*. 2022, pp. 2957–2966.

[3] Kirill Solovev and Nicolas Pröllochs. “Moral emotions shape the virality of COVID-19 misinformation on social media”. In: *Proceedings of the ACM Web Conference 2022*. 2022, pp. 3706–3717.

[4] Arkaitz Zubiaga et al. “Detection and resolution of rumours in social media: A survey”. In: *ACM Computing Surveys (CSUR)* 51.2 (2018), pp. 1–36.

[5] Bin Guo et al. “The future of false information detection on social media: New perspectives and trends”. In: *ACM Computing Surveys (CSUR)* 53.4 (2020), pp. 1–36.

[6] Hamid Karimi et al. “Multi-source multi-class fake news detection”. In: *Proceedings of the 27th international conference on computational linguistics*. 2018, pp. 1546–1557.

[7] Kai Shu et al. “Fake news detection on social media: A data mining perspective”. In: *ACM SIGKDD explorations newsletter* 19.1 (2017), pp. 22–36.

[8] Sushila Shelke and Vahida Attar. “Source detection of rumor in social network – A review”. In: *Online Social Networks and Media* 9 (Jan. 2019), pp. 30–42. ISSN: 2468-6964. DOI: 10.1016/J.OSNEM.2018.12.001.

[9] YanXia Liu et al. “Multi-source detection based on neighborhood entropy in social networks”. In: *Scientific Reports* 12.1 (2022), p. 5467.

[10] Jiaojiao Jiang et al. “K-Center: An Approach on the Multi-Source Identification of Information Diffusion”. In: *IEEE Transactions on Information Forensics and Security* 10.12 (Dec. 2015), pp. 2616–2626. ISSN: 15566013. DOI: 10.1109/TIFS.2015.2469256.

[11] Zhen Wang et al. “A rapid source localization method in the early stage of large-scale network propagation”. In: *Proceedings of the ACM Web Conference 2022*. 2022, pp. 1372–1380.

[12] Qing Liao et al. “An Integrated Multi-Task Model for Fake News Detection”. In: *IEEE Transactions on Knowledge and Data Engineering* 34.11 (2022), pp. 5154–5165. DOI: 10.1109/TKDE.2021.3054993.

[13] Ling Min Serena Khoo et al. “Interpretable Rumor Detection in Microblogs by Attending to User Interactions”. In: *Proceedings of the AAAI Conference on Artificial Intelligence* 34.05 (Apr. 2020), pp. 8783–8790. ISSN: 2374-3468. DOI: 10.1609/AAAI.V34I05.6405. URL: https://ojs.aaai.org/index.php/AAAI/article/view/6405.

[14] Minal Nirav Shah and Amit Ganatra. “A systematic literature review and existing challenges toward fake news detection models”. In: *Social Network Analysis and Mining* 12.1 (Dec. 2022), pp. 1–21. ISSN: 1869-5450. DOI: 10.1007/S13278-022-00995-5/FIGURES/5. URL: https://link.springer.com/article/10.1007/s13278-022-00995-5.

[15] Sarah A Alkhodair et al. “Detecting breaking news rumors of emerging topics in social media”. In: *Information Processing & Management* 57.2 (2020), p. 102018.

[16] Parisa Bazmi, Masoud Asadpour, and Azadeh Shakery. “Multi-view co-attention network for fake news detection by modeling topic-specific user and news source credibility”. In: *Information Processing & Management* 60.1 (Jan. 2023), p. 103146. ISSN: 0306-4573. DOI: 10.1016/J.IPM.2022.103146.

[17] Soroush Vosoughi, Deb Roy, and Sinan Aral. “The spread of true and false news online”. In: *Science* 359.6380 (Mar. 2018), pp. 1146–1151. ISSN: 10959203. DOI: 10.1126/SCIENCE.AAP9559/SUPPL{_}FILE/AAP9559{_}VOSOUGHI{_}SM.PDF. URL: https://www.science.org/doi/10.1126/science.aap9559.

[18] Andrew Guess, Jonathan Nagler, and Joshua Tucker. “Less than you think: Prevalence and predictors of fake news dissemination on Facebook”. In: *Science Advances* 5.1 (2019). ISSN: 19765517. DOI: 10.1126/SCIADV.AAU4586/SUPPL{_}FILE/AAU4586{_}SM.PDF. URL: https://www.science.org/doi/10.1126/sciadv.aau4586.

[19] Nir Grinberg et al. “Political science: Fake news on Twitter during the 2016 U.S. presidential election”. In: *Science* 363.6425 (Jan. 2019), pp. 374–378. ISSN: 10959203. DOI: 10.1126/SCIENCE.AAU2706/SUPPL{_}FILE/AAU2706{_}GRINBERG{_}SM.PDF. URL: https://www.science.org/doi/10.1126/science.aau2706.

[20] Jonas L Juul and Johan Ugander. “Comparing information diffusion mechanisms by matching on cascade size”. In: *Proceedings of the National Academy of Sciences* 118.46 (2021), e2100786118.

[21] Xuerong Ma, Shuling Shen, and Linhe Zhu. “Complex dynamic analysis of a reaction-diffusion network information propagation model with non-smooth control”. In: *Information Sciences* (Dec. 2022). ISSN: 0020-0255. DOI: 10.1016/J.INS.2022.12.013. URL: https://linkinghub.elsevier.com/retrieve/pii/S0020025522015067.

[22] Qian Li et al. “A Predictive Model Based on User Awareness and Multi-Type Rumors Forwarding Dynamics”. In: *Information Sciences* (Nov. 2022). ISSN: 0020-0255. DOI: 10.1016/J.INS.2022.11.072. URL: https://linkinghub.elsevier.com/retrieve/pii/S0020025522013615.

[23] John M Carey et al. “The effects of corrective information about disease epidemics and outbreaks: Evidence from Zika and yellow fever in Brazil”. In: *Science advances* 6.5 (2020), eaaw7449.

[24] Mohsen Mosleh and David G. Rand. “Measuring exposure to misinformation from political elites on Twitter”. In: *Nature Communications 2022 13:1* 13.1 (Nov. 2022), pp. 1–9. ISSN: 2041-1723. DOI: 10.1038/s41467-022-34769-6. URL: https://www.nature.com/articles/s41467-022-34769-6.

[25] Xinyi Zhou et al. ““This is Fake! Shared it by Mistake”: Assessing the Intent of Fake News Spreaders”. In: *Proceedings of the ACM Web Conference 2022*. 2022, pp. 3685–3694.