

Zhiqian Chen

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🔗 <https://imczq.com>
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RESEARCH Fundamental principles of networked system dynamics by integrating machine learning, network science, and dynamical systems. My collaborations span diverse applications, including Social network, Transportation, Spatial Epidemiology, Brain Topology, and Circuit.

Employment

2020-now **Assistant Professor**, *Computer Science and Engineering, Mississippi State University.*

Education

2014–2020 **Virginia Tech**, *Ph.D., Computer Science, Falls Church, Virginia, United States.*

2010–2013 **Peking University**, *M.E., Software Engineering, China.*

2005–2009 **Huazhong University of Science & Technology**, *B.E., Software Engineering, China.*

Grants

Personal Credits: \$ 1,122,628. / Total External: \$ 10,653,443.

NSF CISE MSI: RCBP: III: Advancing Speech Detection: A Hybrid Approach Using Large Language Models and Graph Neural Networks (#2431176) 🔗 [NSF award link](#)

Co-PI/University PI, **\$400,000** (33% credit, MS State share \$259,948.00), 1/2025-12/2026

NSF CIRC: Planning-C: Synergistic Graph Flow Analytics: An Integrated Infrastructure for Bridging Complexity, Fragmentation, and Interdisciplinary Gaps (#2345921) 🔗 [NSF award link](#)

PI, **\$99,998** (60% credit), 7/2024-6/2025

NSF CRII: Interpretable Influence Propagating and Blocking on Graphs (#2153369) 🔗 [NSF award link](#)
PI, **\$174,004** (100% credit), 5/2022-11/2024

USDA [ARS] Developing Detection and Modeling Tools for the Geospatial and Environmental Epidemiology of Animal Disease (#58-6064-3-017) 🔗 [Project Page](#)

Co-PI, **\$3,073,602** (5% credit), 10/2023-08/2028

USDA [ARS] Advancing Agricultural Research through High Performance Computing (#58-0200-0-002)
Co-PI, **\$5,690,689** (5% credit), 10/2022-08/2024

NSF [EDU] ITEST: Learning to create Intelligent Solutions with Machine Learning and Computer Vision: A Pathway to AI Careers for Diverse High School Students (#2342574) 🔗 [NSF award link](#)

Co-PI, **\$1,192,951** (25% credit), 09/2024-08/2027

NSF [III] REU Supplementary, PI, **\$14,000** (100% credit), 11/2023-11/2024

USDA [ARS] Summer Internship Project, PI, **\$8,199** (100% credit), 5/2024-4/2025

Total Internal \$ 17,094.5

MS STATE PI, Center for Teaching and Learning, \$2,994.50 🔗 [Ottillie Schillig Special Teaching Projects Grants](#)

MS STATE PI, Global Development Seed Grant Award, International Institute \$6,000 🔗 [News Page](#)

MS STATE PI, Working Group in Graph AI, Bagley College of Engineering \$4,100

MS STATE Undergrad Research Program, ORED, 2022/2024 (PI, \$2,000), 2023 (Co-PI, \$1,500)

Awards & Honors

AWARD Best Paper Award at ACM SIGSPATIAL 2020 🔗 [Awards Recipients](#)

AWARD Best Paper Award at GISTAM 2015 🔗 [Awards Recipients](#)

AWARD Outstanding Contribution Award, 2016, Toyota Research Institute, North America

HONOR Editor's Choice Article 🔗 [Editor Choices](#)

HONOR Top 50 Chem. & Mater. Sciences Articles in **Nature Communications** 2019 🔗 [Top Paper List](#)

HONOR Excellent Reviewer, IEEE Transactions on Network Science and Engineering, 2024

HONOR Excellent Reviewer (top 20%), SIG KDD, 2025

Presentations

- Tutorial Unifying Spectral and Spatial Graph Neural Network
SDM 2025, May 3, D.C., U.S. [📄 Tutorial page at SDM](#)
- Tutorial Unifying Spectral and Spatial Graph Neural Network
CIKM 2024, Oct 21, Boise, Idaho, U.S. [📄 CIKM tutorial list](#)
- Tutorial Unifying Spectral and Spatial Graph Neural Network
SIAM Math & Data Science 2024, Oct 23, Atlanta, GA, U.S. [📄 Tutorial page at MDS](#)
- Tutorial Unifying Spectral and Spatial Graph Neural Network
CVPR 2024, June 18, Seattle, Washington, U.S. [📄 Tutorial page at CVPR](#)
- Paper Early forecasting of the impact of traffic accidents using a single shot observation
SIAM Data Mining 2022, April, Minneapolis, Minnesota, U.S.
- Tutorial Studying spread patterns of covid-19 based on spatiotemporal data
SIAM Data Mining 2021, April, Online

Teaching

- Undergrad CSE 4633/6633 Artificial Intelligence, CSE 4693/6693 Intro to Machine Learning
- Graduate CSE 8673 Machine Learning, CSE 8990 Graph Machine Learning

Mentoring (as major advisor)

- Ph.D. Zonghan Zhang, Zijian Zhang, Tamanna Rashme, Amin George, Josh Waldbieser, Jiashan Wu, Rocker D'Antonio, Peter Dinh, Josh Dowdy.
- M.S. Md Elias Hossain, Sai Harika Gade, Pavan Dharma Adapa, Matthew Rester, Henry Smith
- Undergrad Jason Weeks, Kevin Ho
- Alumnus **Graduate:** Samuel Prabhakar, Rajeev Jogi, Piero Bracamonte, Suman Adhikari, Ramyasri Veerapaneni, Aymane Jouhari. **Undergrad:** Ben Moore, Jack Maloney, Ethan Rogers, Prathyusha Mustiyala, Andrew McBride, Aalok Uprety, Mason Fisher, Reid Sewell.

Service

- Co-Chair IEEE BigData 2024, Bigdata Cup Challenges [📄 BigData 2024 Organization Committee](#)
- PANELIST NSF Panel, 2021, 2023, 2024
- Editorial Board Frontiers in Big Data - Data Science, Frontiers in Big Data - Data Mining and Management, Frontier Topic Editor, 2022-present
- Reviewer International Conference on Machine Learning (*ICML*), 2021-2024. International Conference on Learning Representations (*ICLR*), 2022-2024. Neural Information Processing System (*NeurIPS*), 2020-2024. AAAI conference on Artificial Intelligence (*AAAI*), 2021-2024. International Joint Conference on Artificial Intelligence (*IJCAI*), 2022-2024. ACM SIG on Knowledge Discovery and Data Mining (*KDD*), 2020-2024. ACM SIG on Information Retrieval (*SIGIR*), 2020, 2022, 2023. IEEE Transactions on Knowledge and Data Engineering (*TKDE*), 2020. ACM Transactions on Knowledge Discovery from Data (*TKDD*), 2021, 2024
- Advisor Mississippi State University AI club [📄 Student Organizations in the Bagley College of Engineering](#)

Publications

- [1] Taoran Ji, Nathan Self, Kaiqun Fu, Zhiqian Chen, Naren Ramakrishnan, and Chang-Tien Lu. Citation forecasting with multi-context attention-aided dependency modeling. *ACM Transactions on Knowledge Discovery from Data*, 18(6):1–23, 2024.
- [2] Kollin Napier, Tanmay Bhowmik, and Zhiqian Chen. Explaining poor performance of text-based machine learning models for vulnerability detection. *Empirical Software Engineering*, 29(5):113, 2024.
- [3] Nisha Pillai, Bindu Nanduri, Michael J Rothrock Jr, Zhiqian Chen, and Mahalingam Ramkumar. Bayesian-guided generation of synthetic microbiomes with minimized pathogenicity. *arXiv preprint arXiv:2405.00070*, 2024.

- [4] Rui Shang, Siji Chen, Zhiqian Chen, and Chang-Tien Lu. Graphnilm: A graph neural network for energy disaggregation. In *Pacific-Asia Conference on Knowledge Discovery and Data Mining*, pages 431–443. Springer Nature Singapore Singapore, 2024.
- [5] Zirui Yuan, Minglai Shao, and Zhiqian Chen. Graph bayesian optimization for multiplex influence maximization. In *Proceedings of the AAAI Conference on Artificial Intelligence*, volume 38, pages 22475–22483, 2024.
- [6] Lei Zhang, Zhiqian Chen, Chang-Tien Lu, and Liang Zhao. Network interdiction goes neural. *arXiv preprint arXiv:2405.16409*, 2024.
- [7] Zijian Zhang, Zonghan Zhang, and Zhiqian Chen. Flowgpt: How long can llms trace back and predict the trends of graph dynamics? In *SouthNLP*, 2024.
- [8] Zonghan Zhang, Zijian Zhang, and Zhiqian Chen. Multiple-source localization from a single-snapshot observation using graph bayesian optimization. In *Proceedings of the AAAI Conference on Artificial Intelligence*, volume 38, pages 22538–22546, 2024.
- [9] Yaya Zhao, Kaiqi Zhao, Zhiqian Chen, Yuanyuan Zhang, Yalei Du, and Xiaoling Lu. A graph-based representation framework for trajectory recovery via spatiotemporal interval-informed seq2seq. In *Proceedings of the Thirty-Third International Joint Conference on Artificial Intelligence (IJCAI-24)*, pages 2588–2597. <https://doi.org/10.24963/ijcai.2024/286>, 2024.
- [10] Kourosh T Baghaei, Amirreza Payandeh, Pooya Fayyazsanavi, Zhiqian Chen, Somayeh Bakhtiari Ramezani, and Shahram Rahimi. Deep representation learning: Fundamentals, technologies, applications, and open challenges. *IEEE Access*, 2023.
- [11] Subhodip Biswas, Fanglan Chen, Zhiqian Chen, Chang-Tien Lu, and Naren Ramakrishnan. Memetic algorithms for spatial partitioning problems. *ACM Transactions on Spatial Algorithms and Systems*, 9(1):1–31, 2023.
- [12] Fanglan Chen, Subhodip Biswas, Zhiqian Chen, Shuo Lei, Naren Ramakrishnan, and Chang-Tien Lu. Exploring tradeoffs in automated school redistricting: Computational and ethical perspectives. In *Proceedings of the AAAI Conference on Artificial Intelligence*, volume 37, pages 15912–15920, 2023.
- [13] Zhiqian Chen, Fanglan Chen, Lei Zhang, Taoran Ji, Kaiqun Fu, Liang Zhao, Feng Chen, Lingfei Wu, Charu Aggarwal, and Chang-Tien Lu. Bridging the gap between spatial and spectral domains: A unified framework for graph neural networks. *ACM Computing Surveys*, 56(5):42, 2023.
- [14] Nisha Pillai, Bindu Nanduri, Michael J Rothrock, Zhiqian Chen, and Mahalingam Ramkumar. Towards optimal microbiome to inhibit multidrug resistance. In *2023 IEEE Conference on Computational Intelligence in Bioinformatics and Computational Biology (CIBCB)*, pages 1–9. IEEE, 2023.
- [15] Lei Zhang, Zhiqian Chen, Chang-Tien Lu, and Liang Zhao. Fast and adaptive dynamics-on-graphs to dynamics-of-graphs translation. *Frontiers in big Data*, 6:1274135, 2023.
- [16] Lei Zhang, Qisheng Zhang, Zhiqian Chen, Yanshen Sun, Chang-Tien Lu, and Liang Zhao. Infinitely deep graph transformation networks. In *2023 IEEE International Conference on Data Mining (ICDM)*, pages 778–787. IEEE Computer Society, 2023.
- [17] Zijian Zhang, Zonghan Zhang, and Zhiqian Chen. Xflow: Benchmarking flow behaviors over graphs. *arXiv preprint arXiv:2308.03819*, 2023.
- [18] Zonghan Zhang and Zhiqian Chen. Accelerating simulation-based influence maximization via bayesian optimization. In *openreview.net*, 2023.
- [19] Zonghan Zhang and Zhiqian Chen. Understanding influence maximization via higher-order decomposition. In *Proceedings of the 2023 SIAM International Conference on Data Mining (SDM)*, pages 766–774. Society for Industrial and Applied Mathematics, 2023.
- [20] Subhodip Biswas, Fanglan Chen, Zhiqian Chen, Chang-Tien Lu, and Naren Ramakrishnan. Sampling-based techniques for designing school boundaries. *arXiv preprint arXiv:2206.03703*, 2022.

- [21] Zhiqian Chen and Zonghan Zhang. Demystifying graph convolution with a simple concatenation. *arXiv preprint arXiv:2207.12931*, 2022.
- [22] Guangyu Meng, Qisheng Jiang, Kaiqun Fu, Beiyu Lin, Chang-Tien Lu, and Zhiqian Chen. Early forecasting of the impact of traffic accidents using a single shot observation. In *Proceedings of the 2022 SIAM International Conference on Data Mining (SDM)*, pages 100–108. Society for Industrial and Applied Mathematics, 2022.
- [23] Setareh Rafatirad, Houman Homayoun, Zhiqian Chen, and Sai Manoj Pudukotai Dinakarrrao. Machine learning for computer scientists and data analysts: from an applied perspective, 2022.
- [24] Setareh Rafatirad, Houman Homayoun, Zhiqian Chen, and Sai Manoj Pudukotai Dinakarrrao. Adversarial machine learning. In *Machine Learning for Computer Scientists and Data Analysts: From an Applied Perspective*, pages 305–328. Springer International Publishing Cham, 2022.
- [25] Setareh Rafatirad, Houman Homayoun, Zhiqian Chen, and Sai Manoj Pudukotai Dinakarrrao. Applied machine learning for cloud resource management. In *Machine Learning for Computer Scientists and Data Analysts: From an Applied Perspective*, pages 405–427. Springer International Publishing Cham, 2022.
- [26] Setareh Rafatirad, Houman Homayoun, Zhiqian Chen, and Sai Manoj Pudukotai Dinakarrrao. A brief review of probability theory and linear algebra. *Machine Learning for Computer Scientists and Data Analysts: From an Applied Perspective*, pages 35–79, 2022.
- [27] Setareh Rafatirad, Houman Homayoun, Zhiqian Chen, and Sai Manoj Pudukotai Dinakarrrao. Graph learning. In *Machine Learning for Computer Scientists and Data Analysts: From an Applied Perspective*, pages 277–304. Springer International Publishing Cham, 2022.
- [28] Setareh Rafatirad, Houman Homayoun, Zhiqian Chen, and Sai Manoj Pudukotai Dinakarrrao. Online learning. In *Machine Learning for Computer Scientists and Data Analysts: From an Applied Perspective*, pages 235–256. Springer International Publishing Cham, 2022.
- [29] Setareh Rafatirad, Houman Homayoun, Zhiqian Chen, and Sai Manoj Pudukotai Dinakarrrao. Recommender learning. In *Machine Learning for Computer Scientists and Data Analysts: From an Applied Perspective*, pages 257–276. Springer International Publishing Cham, 2022.
- [30] Setareh Rafatirad, Houman Homayoun, Zhiqian Chen, and Sai Manoj Pudukotai Dinakarrrao. Reinforcement learning. In *Machine Learning for Computer Scientists and Data Analysts: From an Applied Perspective*, pages 217–232. Springer International Publishing Cham, 2022.
- [31] Setareh Rafatirad, Houman Homayoun, Zhiqian Chen, and Sai Manoj Pudukotai Dinakarrrao. Sensornet: An educational neural network framework for low-power multimodal data classification. In *Machine Learning for Computer Scientists and Data Analysts: From an Applied Perspective*, pages 331–357. Springer International Publishing Cham, 2022.
- [32] Setareh Rafatirad, Houman Homayoun, Zhiqian Chen, and Sai Manoj Pudukotai Dinakarrrao. Supervised learning. In *Machine Learning for Computer Scientists and Data Analysts: From an Applied Perspective*, pages 81–162. Springer International Publishing Cham, 2022.
- [33] Setareh Rafatirad, Houman Homayoun, Zhiqian Chen, and Sai Manoj Pudukotai Dinakarrrao. Transfer learning in mobile health. In *Machine Learning for Computer Scientists and Data Analysts: From an Applied Perspective*, pages 359–382. Springer International Publishing Cham, 2022.
- [34] Setareh Rafatirad, Houman Homayoun, Zhiqian Chen, and Sai Manoj Pudukotai Dinakarrrao. Unsupervised learning. In *Machine Learning for Computer Scientists and Data Analysts: From an Applied Perspective*, pages 163–216. Springer International Publishing Cham, 2022.
- [35] Jason Wang, Kaiqun Fu, Zhiqian Chen, and Chang-Tien Lu. Augmentation of chinese character representations with compositional graph learning (student abstract). In *Proceedings of the AAAI Conference on Artificial Intelligence*, volume 36, pages 13075–13076, 2022.
- [36] Lei Zhang, Zhiqian Chen, Chang-Tien Lu, and Liang Zhao. From “dynamics on graphs” to “dynamics of graphs”: An adaptive echo-state network solution (student abstract). In *Proceedings of the AAAI Conference on Artificial Intelligence*, volume 36, pages 13111–13112, 2022.

- [37] Zonghan Zhang, Subhodip Biswas, Fanglan Chen, Kaiqun Fu, Taoran Ji, Chang-Tien Lu, Naren Ramakrishnan, and Zhiqian Chen. Blocking influence at collective level with hard constraints (student abstract). In *Proceedings of the AAAI Conference on Artificial Intelligence*, volume 36, pages 13115–13116, 2022.
- [38] Zhiqian Chen, Lei Zhang, Gaurav Kolhe, Hadi Mardani Kamali, Setareh Rafatirad, Sai Manoj Pudukotai Dinakarrao, Houman Homayoun, Chang-Tien Lu, and Liang Zhao. Deep graph learning for circuit deobfuscation. *Frontiers in big Data*, 4:608286, 2021.
- [39] Kaiqun Fu, Taoran Ji, Nathan Self, Zhiqian Chen, and Chang-Tien Lu. A hierarchical attention graph convolutional network for traffic incident impact forecasting. In *2021 IEEE International Conference on Big Data (Big Data)*, pages 1619–1624. IEEE, 2021.
- [40] Taoran Ji, Nathan Self, Kaiqun Fu, Zhiqian Chen, Naren Ramakrishnan, and Chang-Tien Lu. Dynamic multi-context attention networks for citation forecasting of scientific publications. In *Proceedings of the AAAI Conference on Artificial Intelligence*, volume 35, pages 7953–7960, 2021.
- [41] Guoming Li, Yanbo Huang, Zhiqian Chen, Gary D Chesser Jr, Joseph L Purswell, John Linhoss, and Yang Zhao. Practices and applications of convolutional neural network-based computer vision systems in animal farming: A review. *Sensors*, 21(4):1492, 2021.
- [42] Guoming Li, Xue Hui, Zhiqian Chen, Gary D Chesser Jr, and Yang Zhao. Development and evaluation of a method to detect broilers continuously walking around feeder as an indication of restricted feeding behaviors. *Computers and electronics in agriculture*, 181:105982, 2021.
- [43] Beiyu Lin, Xiaowei Jia, and Zhiqian Chen. Sdm 21 tutorial: Studying spread patterns of covid-19 based on spatiotemporal data. In *SIAM Data Mining 2021*, 2021.
- [44] Padmaksha Roy, Shailik Sarkar, Subhodip Biswas, Fanglan Chen, Zhiqian Chen, Naren Ramakrishnan, and Chang-Tien Lu. Deep diffusion-based forecasting of covid-19 by incorporating network-level mobility information. In *Proceedings of the 2021 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining*, pages 168–175, 2021.
- [45] Subhodip Biswas, Fanglan Chen, Zhiqian Chen, Chang-Tien Lu, and Naren Ramakrishnan. Incorporating domain knowledge into memetic algorithms for solving spatial optimization problems. In *Proceedings of the 28th International Conference on Advances in Geographic Information Systems*, pages 25–35, 2020.
- [46] Subhodip Biswas, Fanglan Chen, Andreea Sistrunk, Sathappan Muthiah, Zhiqian Chen, Nathan Self, Chang-Tien Lu, and Naren Ramakrishnan. Geospatial clustering for balanced and proximal schools. In *Proceedings of the AAAI Conference on Artificial Intelligence*, volume 34, pages 13358–13365, 2020.
- [47] Fanglan Chen, Zhiqian Chen, Subhodip Biswas, Shuo Lei, Naren Ramakrishnan, and Chang-Tien Lu. Graph convolutional networks with kalman filtering for traffic prediction. In *Proceedings of the 28th international conference on advances in geographic information systems*, pages 135–138, 2020.
- [48] Zhiqian Chen, Gaurav Kolhe, Setareh Rafatirad, Chang-Tien Lu, Sai Manoj PD, Houman Homayoun, and Liang Zhao. Estimating the circuit de-obfuscation runtime based on graph deep learning. In *2020 Design, Automation & Test in Europe Conference & Exhibition (DATE)*, pages 358–363. IEEE, 2020.
- [49] Zhao Ding, Zhiqian Chen, Tianyi Ma, Chang-Tien Lu, Wenhui Ma, and Leon Shaw. Predicting the hydrogen release ability of libh4-based mixtures by ensemble machine learning. *Energy Storage Materials*, 27:466–477, 2020.
- [50] Zhao Ding, Shaoyuan Li, Yang Zhou, Zhiqian Chen, Weijie Yang, Wenhui Ma, and Leon Shaw. Libh4 for hydrogen storage-new perspectives. *Nano Materials Science*, 2(2):109–119, 2020.
- [51] Jianfeng He, Xuchao Zhang, Shuo Lei, Zhiqian Chen, Fanglan Chen, Abdulaziz Alhamadani, Bei Xiao, and Chang-Tien Lu. Towards more accurate uncertainty estimation in text classification. In *Proceedings of the 2020 Conference on Empirical Methods in Natural Language Processing (EMNLP)*, pages 8362–8372, 2020.

- [52] Subhodip Biswas, Fanglan Chen, Zhiqian Chen, Andreea Sistrunk, Nathan Self, Chang-Tien Lu, and Naren Ramakrishnan. Regal: A regionalization framework for school boundaries. In *Proceedings of the 27th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems*, pages 544–547, 2019.
- [53] Taoran Ji, Zhiqian Chen, Nathan Self, Kaiqun Fu, Chang-Tien Lu, and Naren Ramakrishnan. Patent citation dynamics modeling via multi-attention recurrent networks. In *Proceedings of the Twenty-Eighth International Joint Conference on Artificial Intelligence (IJCAI-19)*, 2019.
- [54] Ying Zhang, Xingfeng He, Zhiqian Chen, Qiang Bai, Adelaide M Nolan, Charles A Roberts, Debasish Banerjee, Tomoya Matsunaga, Yifei Mo, and Chen Ling. Unsupervised discovery of solid-state lithium ion conductors. *Nature communications*, 10(1):5260, 2019.
- [55] Zhiqian Chen, Feng Chen, Rongjie Lai, Xuchao Zhang, and Chang-Tien Lu. Rational neural networks for approximating graph convolution operator on jump discontinuities. In *2018 IEEE International Conference on Data Mining (ICDM)*, pages 59–68. IEEE, 2018.
- [56] Kaiqun Fu, Zhiqian Chen, and Chang-Tien Lu. Streetnet: preference learning with convolutional neural network on urban crime perception. In *Proceedings of the 26th ACM SIGSPATIAL international conference on advances in geographic information systems*, pages 269–278, 2018.
- [57] Manu Shukla, Zhiqian Chen, and Chang-Tien Lu. Dimpl: a distributed in-memory drone flight path builder system. *Journal of Big Data*, 5:1–29, 2018.
- [58] Bingsheng Wang, Zhiqian Chen, Arnold P Boedihardjo, and Chang-Tien Lu. Virtual metering: An efficient water disaggregation algorithm via nonintrusive load monitoring. *ACM Transactions on Intelligent Systems and Technology (TIST)*, 9(4):1–30, 2018.
- [59] Xuchao Zhang, Liang Zhao, Zhiqian Chen, and Chang-Tien Lu. Distributed self-paced learning in alternating direction method of multipliers. *arXiv preprint arXiv:1807.02234*, 2018.
- [60] Zhiqian Chen, Chih-Wei Wu, Yen-Cheng Lu, Alexander Lerch, and Chang-Tien Lu. Learning to fuse music genres with generative adversarial dual learning. In *2017 IEEE International Conference on Data Mining (ICDM)*, pages 817–822. IEEE, 2017.
- [61] Zhiqian Chen, Xuchao Zhang, Arnold P Boedihardjo, Jing Dai, and Chang-Tien Lu. Multimodal storytelling via generative adversarial imitation learning. In *Proceedings of the Twenty-Sixth International Joint Conference on Artificial Intelligence (IJCAI-17)*, 2017.
- [62] Xuchao Zhang, Zhiqian Chen, Liang Zhao, Arnold P Boedihardjo, and Chang-Tien Lu. Traces: Generating twitter stories via shared subspace and temporal smoothness. In *2017 IEEE International Conference on Big Data (Big Data)*, pages 1688–1693. IEEE, 2017.
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- [66] Zhiqian Chen and Wenya Feng. Detecting impolite crawler by using time series analysis. In *2013 IEEE 25th International Conference on Tools with Artificial Intelligence*, pages 123–126. IEEE, 2013.