

# Kai-Cheng Yang

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CONTACT INFORMATION	Luddy School of Informatics, Computing, and Engineering Indiana University Bloomington 1015 E. 11th Street Bloomington, IN 47408	(812) 955-8786 yangkc@iu.edu kaichengyang.me Google Scholar
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EDUCATION	Ph.D., Informatics, Complex Systems track, Indiana University Committee: Filippo Menczer, Yong-Yeol Ahn, Brea Perry, Alessandro Flammini M.S., Theoretical Physics, Lanzhou University (China) B.S., Theoretical Physics, Lanzhou University (China)	2022 (expected) Jun. 2017 Jun. 2014
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RESEARCH PROJECTS	<b>Social Media</b> Mining social media data to: <ul style="list-style-type: none"><li>• Reveal the prevalence [R1, J8, W3], dissemination [J20], and real-world implications of online misinformation [J6];</li><li>• Detect social bots with machine learning [J2, C2, C3, J17]; study their role [J4] and human perception [J11];</li><li>• Probe platform bias [J3, J16];</li></ul> <b>Public Health</b> Analyzing large-scale medical claims datasets to: <ul style="list-style-type: none"><li>• Study the opioid epidemic in the US [J9]; estimate the effectiveness of intervention policies [J10]; identify at-risk patients [J1, J5, J18]</li></ul> <b>Network Science</b> <ul style="list-style-type: none"><li>• Propose and evaluate network embedding methods [J12–J14]</li><li>• Model spreading phenomenon [J19, J21]</li></ul>
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HONORS & AWARDS	Affiliate, Center for Information, Technology, and Public Life, UNC-Chapel Hill IU GISA Conference Travel Award (\$300) Best Reviewer Award at AAAI ICWSM 2022 Selected for Future Leaders Summit 2022, University of Michigan IU Luddy Outstanding Research Award (\$500) IU School of Public Health Big Idea Challenge (\$250) IU Informatics Ph.D. Student Conference Travel Award (\$1000) IU GISA Conference Travel Award (\$700) IU Informatics Ph.D. Student Conference Travel Award (\$1000) NSF Research Trainee scholarship in Complex Networks and Systems (\$5000)	2022 2022 2022 2022 2021 2020 2020 2019 2019 2018
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PUBLICATIONS	<b>Journal Articles</b>
GOOGLE SCHOLAR	
CITATIONS: 2,347	J1. Yang, K.-C., Aronson, B., Odabas, M., Ahn, Y.-Y. & Perry, B. L. Comparing measures of centrality in bipartite patient-prescriber networks: A study of drug seeking for opioid analgesics. <i>PLoS ONE</i> 17, e0273569 (2022).
H-INDEX: 15	J2. Yang, K.-C., Ferrara, E. & Menczer, F. Botometer 101: Social bot practicum for computational social scientists. <i>Journal of Computational Social Science</i> (2022).
I10-INDEX: 17	

- J3. **Yang, K.-C.**, Hui, P.-M. & Menczer, F. How Twitter data sampling biases U.S. voter behavior characterizations. *PeerJ Computer Science* **8**, e1025 (2022).
- J4. Duan, Z., Li, J., Lukito, J., **Yang, K.-C.**, Chen, F., Shah, D. V. & Yang, S. Algorithmic Agents in the Hybrid Media System: Social Bots, Selective Amplification, and Partisan News about COVID-19. *Human Communication Research* **48**, 516–542 (2022).
- J5. Perry, B. L., Odabas, M., **Yang, K.-C.**, Lee, B., Kaminski, P., Aronson, B., Ahn, Y.-Y., Oser, C. B., Freeman, P. R. & Talbert, J. C. New means, new measures: Assessing prescription drug seeking indicators over ten years of the opioid epidemic. *Addiction* **117**, 195–204 (2022).
- J6. Pierri, F., Perry, B. L., DeVerna, M., **Yang, K.-C.**, Flammini, A., Menczer, F. & Bryden, J. Online misinformation is linked to early COVID-19 vaccination hesitancy and refusal. *Scientific Reports* **12**, 5966 (2022).
- J7. **Yang, K.-C.**, Lee, B., Ahn, Y.-Y. & Perry, B. L. Use of and Comorbidities Associated With Diagnostic Codes for COVID-19 in US Health Insurance Claims. *JAMA Network Open* **4**, e2124643 (2021).
- J8. **Yang, K.-C.**, Pierri, F., Hui, P.-M., Axelrod, D., Torres-Lugo, C., Bryden, J. & Menczer, F. The COVID-19 Infodemic: Twitter versus Facebook. *Big Data & Society* **8**, 20539517211013861 (2021).
- J9. Lee, B., **Yang, K.-C.**, Kaminski, P., Ahn, Y.-Y., Peng, S., Odabas, M., Gupta, S., Green, H. & Perry, B. L. Substitution of Nonpharmacologic Therapy With Opioid Prescribing for Pain During the COVID-19 Pandemic. *JAMA Network Open* **4**, e2138453 (2021).
- J10. Lee, B., Zhao, W., **Yang, K.-C.**, Ahn, Y.-Y. & Perry, B. L. Systematic Evaluation of State Policy Interventions Targeting the US Opioid Epidemic, 2007-2018. *JAMA Network Open* **4**, e2036687 (2021).
- J11. Yan, H., **Yang, K.-C.**, Menczer, F. & Shanahan, J. Asymmetrical Perceptions of Partisan Political Bots. *New Media & Society* **23**, 3016–3037 (2021).
- J12. Yoon, J., **Yang, K.-C.**, Jung, W.-S. & Ahn, Y.-Y. Persona2vec: A Flexible Multi-role Representations Learning Framework for Graphs. *PeerJ Computer Science* **7**, e174 (2021).
- J13. Zhang, Y.-J., **Yang, K.-C.** & Radicchi, F. Model-free hidden geometry of complex networks. *Physical Reviews E* **103**, 012305 (2021).
- J14. Zhang, Y.-J., **Yang, K.-C.** & Radicchi, F. Systematic comparison of graph embedding methods in practical tasks. *Physical Reviews E* **104**, 044315 (2021).
- J15. Pasquetto, I. V., Swire-Thompson, B., Amazeen, M. A., Benevenuto, F., Brashier, N., Bond, R. M., Bozarth, L. C., Budak, C., Ecker, U. K., ... & **Yang, K.-C.** Tackling misinformation: What researchers could do with social media data. *The Harvard Kennedy School (HKS) Misinformation Review* **1** (2020).
- J16. Wen, C., Pacheco, D., **Yang, K.-C.** & Menczer, F. Neutral bots probe political bias on social media. *Nature Communications* **12**, 5580 (2020).
- J17. **Yang, K.-C.**, Varol, O., Davis, C. A., Ferrara, E., Flammini, A. & Menczer, F. Arming the public with artificial intelligence to counter social bots. *Human Behavior and Emerging Technologies*, e115 (2019).
- J18. Perry, B. L., **Yang, K.-C.**, Kaminski, P., Odabas, M., Park, J., Martel, M., Oser, C. B., Freeman, P. R., Ahn, Y.-Y. & Talbert, J. Co-prescription network reveals social dynamics of opioid doctor shopping. *PLoS ONE* **14**, e0223849 (2019).

- J19. Zhang, Y.-J., Wu, Z.-X., Holme, P. & **Yang, K.-C.** Advantage of Being Multicomponent and Spatial: Multipartite Viruses Colonize Structured Populations with Lower Thresholds. *Physical Reviews Letters* **123**. (Editors' Suggestion), 138101 (2019).
- J20. Shao, C., Ciampaglia, G. L., Varol, O., **Yang, K.-C.**, Flammini, A. & Menczer, F. The spread of low-credibility content by social bots. *Nature Communications* **9**, 4787 (2018).
- J21. **Yang, K.-C.**, Wu, Z.-X., Holme, P. & Nonaka, E. Expansion of cooperatively growing populations: Optimal migration rates and habitat network structures. *Physical Reviews E* **95**, 012306 (2017).

#### Peer-reviewed Conference Proceedings

- C1. Torres-Lugo, C., **Yang, K.-C.** & Menczer, F. *The Manufacture of Partisan Echo Chambers by Follow Train Abuse on Twitter in Proceedings of the International AAAI Conference on Web and Social Media (ICWSM)* **16** (2022), 1017–1028.
- C2. **Yang, K.-C.**, Varol, O., Hui, P.-M. & Menczer, F. *Scalable and Generalizable Social Bot Detection through Data Selection in Proceedings of the AAAI Conference on Artificial Intelligence (AAAI)* **34** (New York, NY, USA, 2020), 1096–1103.
- C3. Sayyadiharikandeh, M., Varol, O., **Yang, K.-C.**, Flammini, A. & Menczer, F. *Detection of Novel Social Bots by Ensembles of Specialized Classifiers in Proceedings of the 29th ACM International Conference on Information & Knowledge Management (CIKM)* (Virtual, 2020), 2725–2732.

#### Peer-reviewed Workshop/Demo/Dataset/Software Papers

- W1. DeVerna, M. R., Pierri, F., Truong, B. T., Bollenbacher, J., Axelrod, D., Loynes, N., Torres-Lugo, C., **Yang, K.-C.**, Menczer, F. & Bryden, J. *CoVaxxy: A Collection of English-Language Twitter Posts About COVID-19 Vaccines in Proceedings of the International AAAI Conference on Web and Social Media (ICWSM)* **15** (Virtual, 2021), 992–999.
- W2. **Yang, K.-C.**, Aronson, B. & Ahn, Y.-Y. BiRank: Fast and Flexible Ranking on Bipartite Networks with R and Python. *Journal of Open Source Software* **5**, 2315 (2020).
- W3. **Yang, K.-C.**, Torres-Lugo, C. & Menczer, F. *Prevalence of Low-Credibility Information on Twitter During the COVID-19 Outbreak in Proceedings of the ICWSM International Workshop on Cyber Social Threats (CySoc)* (Virtual, 2020).
- W4. Hui, P.-M., **Yang, K.-C.**, Torres-Lugo, C. & Menczer, F. *BotSlayer: DIY Real-Time Influence Campaign Detection in Proceedings of the International AAAI Conference on Web and Social Media (ICWSM)* **14** (Virtual, 2020), 980–982.
- W5. **Yang, K.-C.**, Hui, P.-M. & Menczer, F. *Bot Electioneering Volume: Visualizing Social Bot Activity During Elections in Companion Proceedings of The 2019 World Wide Web Conference (WWW)* (San Francisco, CA, USA, 2019), 214–217.
- W6. Hui, P.-M., **Yang, K.-C.**, Torres-Lugo, C., Monroe, Z., McCarty, M., Serrette, B., Pentchev, V. & Menczer, F. BotSlayer: real-time detection of bot amplification on Twitter. *Journal of Open Source Software* **4**, 1706 (2019).

#### Under Review

- R1. Pierri, F., DeVerna, M. R., **Yang, K.-C.**, Axelrod, D., Bryden, J. & Menczer, F. One year of COVID-19 vaccine misinformation on Twitter. *arXiv: 2209.01675* (2022).
- R2. Yan, H. & **Yang, K.-C.** The landscape of social bot research: a critical appraisal. *OSF Preprint*. <https://doi.org/10.31219/osf.io/3cf4j> (2022).

#### Other Works

- O1. **Yang, K.-C. & Menczer, F.** *How many bots are on Twitter? The question is difficult to answer and misses the point.* The Conversation (<https://theconversation.com/how-many-bots-are-on-twitter-the-question-is-difficult-to-answer-and-misses-the-point-183425>). 2022.

## TOOLS

### Observatory on Social Media (OSoMe)

- **Botometer**<sup>®</sup> [J2, C3, J17], **BotometerLite** [C2]: popular bot detection tools handling 250,000 daily requests from researchers, journalists, and social media users; used by Elon Musk's team in his dispute with Twitter (via **CNN**, **BBC**, and **Yahoo! Finance**)
- **BotAmp** [J2]: bot amplification level comparison
- **BotSlayer** [W4, W6], **Hoaxy**<sup>®</sup>: bot amplification detection & visualization tools with thousands of users
- **OSoMeTweet** (**GitHub**, **PyPI**): Python library for accessing Twitter's V2 API
- **CoVaxxy** [W1]: dashboard for COVID-19 vaccine Twitter discussion

### Network Science

- **Persona2vec** (**GitHub**) [J12]: multi-role representations embedding for networks
- **BiRank** (**GitHub**, **PyPI**, **CRAN**) [W2]: bipartite network PageRank

## PRESENTATIONS Tutorials and Demos

- Identifying Social Media Manipulation with OSoMe Tools  
*Computation + Journalism Conference – C+J 2022 (Virtual)* Jun. 2022  
*IC<sup>2</sup>S<sup>2</sup> 2020 (Virtual)* Jul. 2020
- Introduction to **Botometer**<sup>®</sup>  
*Visit by former Dominican Republic president Leonel Fernández (Bloomington, USA)* Apr. 2022  
*Invited demo at the Learning Informatics Lab, University of Minnesota (Virtual)* Mar. 2022  
*Knight Research Network Tool Demonstration Day (Virtual)* Oct. 2021
- Fast and Flexible Ranking on Bipartite Networks with Python and R  
*Indiana University Network Institute workshop series (Bloomington, USA)* Nov. 2021

### Talks

- The COVID-19 Infodemic: prevalence, adverse actors, and real-world impact [J6, J8, W3]  
*Invited talk at Computational Social Science Lab at Penn (Virtual)* Jun. 2022  
*Future Leaders Summit 2022 (Ann Arbor, USA)* Apr. 2022
- The COVID-19 Infodemic: Twitter versus Facebook [J8]  
*Social Media Lab Guest Speaker Series (Virtual)* Oct. 2021  
*IC<sup>2</sup>S<sup>2</sup> 2021 (Virtual)* Jul. 2021  
*NetSci 2021 (Virtual)* Jul. 2021  
*Computation + Journalism Symposium — C+J 2021 (Virtual)* Feb. 2021  
*The 3rd North American Social Networks Conference — NASN 2021 (Virtual)* Jan. 2021
- Bipartite Network Centrality Comparison: A Study of Opioid Doctor Shopping [J1]  
*IC<sup>2</sup>S<sup>2</sup> 2020 (Virtual)* Jul. 2020
- Prevalence of Low-Credibility Information on Twitter During the COVID-19 Outbreak [W3]  
*CySoc 2020 (Virtual)* Jun. 2020
- **BotometerLite** [C2]  
*IC<sup>2</sup>S<sup>2</sup> 2020 (Virtual)* Jul. 2020  
*AAAI 2020 (New York, USA)* Feb. 2020
- Bot Electioneering Volume [W5]  
*CyberSafety 2019 (San Francisco, USA)* May 2019

WORKING EXPERIENCE	<b>TikTok Inc. (ByteDance), CA, USA</b>	
	Security engineering intern	Summer 2021
	<b>Indiana University, IN, USA</b>	
	Research assistant, doctor shopping project	2018 – 2022
TEACHING EXPERIENCE	<b>Indiana University, IN, USA</b>	
	Mentor, Undergraduate Research Opportunities in Computing Associate instructor, I590 Applied Data Science	2021 – 2022 Fall 2017, Spring 2018
SERVICE	<p><b>Journal Reviewer:</b> Scientific Reports (22); JMIR Public Health and Surveillance (22); Royal Society Open Science (22); Journal of Medical Internet Research (22); Online Social Networks and Media (21, 22); PeerJ Computer Science (20, 22); JMIR Infodemiology (22); Journal of Computational Social Science (22); Social Network Analysis and Mining (21, 22); Frontiers in Public Health (22); Journal of the Royal Society Interface (22); International Journal of Human-Computer Interaction (22); PLoS ONE (21, 22); Political Research Exchange (21); International Journal of Information Technology &amp; Decision Making (21); Computers &amp; Security (21); International Journal of Data Science and Analytics (21); International Communication Gazette (21); Big Data &amp; Society (21); Information, Communication and Society (21); Information Processing &amp; Management (21); IEEE Transactions on Knowledge and Data Engineering (21); Humanities &amp; Social Sciences Communications (21); IEEE Internet Computing (21); ACM Digital Threats: Research and Practice (21);</p> <p><b>Conference Reviewer:</b> CSCW (22); ICWSM (20-22); CIKM (21,22);</p> <p><b>Workshop Organizer:</b> <i>International Workshop on Cyber Social Threats 2022 (CySoc)</i></p>	
IN THE PRESS	<p><b>Selected Quotations and Interviews</b></p> <ul style="list-style-type: none"> <li>Social bots and other inauthentic actors on social media <i>BBC (Aug. 2022); Ars Technica (Aug. 2022); Yahoo! Finance (Aug. 2022); CNN (Aug. 2022); Yahoo! Finance (Aug. 2022); CNN (Jun. 2022); The Wall Street Journal (Jun. 2022); The Washington Post (May 2022); Politico (May 2022); Business Insider (May 2022); Yahoo! News (May 2022); Spectrum News (Apr. 2022);</i></li> <li>Online misinformation <i>IEEE Spectrum (Jul. 2020);</i></li> </ul> <p><b>Selected Media Coverage of My Works</b></p> <ul style="list-style-type: none"> <li><b>Botometer<sup>®</sup> [C3, J17] &amp; BotAmp</b> <i>CNN (Sep. 2022); Quotidiano Nazionale (Aug. 2022); The Guardian (Aug. 2022); The National Interest (Aug. 2022); The Verge (Aug. 2022); Yahoo! Finance (Aug. 2022); CNN (Aug. 2022); CNBC (Aug. 2022); Washington Examiner (Aug. 2022); Engadget (Aug. 2022); The Washington Post (Aug. 2022); The New York Times (Aug. 2022); Inc. Magazine (Aug. 2022); Newsweek (Aug. 2022); Snopes (Jul. 2022); USA Today (Jun. 2022); Slate (Jun. 2022); Forbes (Jun. 2022); Wired (May 2022); The Washington Post (May 2022); Los Angeles Times (Apr. 2022); Reuters (Nov. 2018);</i></li> <li><b>CoVaxxy [W1]</b> <i>The New York Times (May 2022); AP News (Dec. 2021); USA Today (Mar. 2021);</i></li> <li>Online misinformation is linked to early COVID-19 vaccination hesitancy and refusal [J6] <i>Global Citizen (Aug. 2022); Medical News Today (Aug. 2022); Time (May 2022); News-Medical (May 2022); Tech Policy Press (Apr. 2022); Slate (Apr. 2022);</i></li> <li>Neutral bots probe political bias on social media [J16]</li> </ul>	

- *NBC News (Apr. 2022); Metro (Apr. 2022); Rolling Stone (Apr. 2022);*
- COVID-19 Infodemic on Twitter and Facebook [J8]  
*News 5 (Jan. 2022); The Conversation (Jul. 2021);*
- Substitution of Nonpharmacologic Therapy With Opioid Prescribing for Pain During the COVID-19 Pandemic [J9]  
*Clinical Pain Advisor (Jan. 2022); Everyday Health (Dec. 2021); Health Day (Dec. 2021);*
- Systematic evaluation of state policy interventions targeting the US opioid epidemic [J10]  
*MedPage Today (Jan. 2022); U.S. Pharmacist (Mar. 2021); News-Medical (Feb. 2021);*
- Hoaxy<sup>®</sup>  
*Bloomberg (Nov. 2020); NBC News (Feb. 2020); Mother Jones (Feb. 2020); NBC News (Jan. 2020); Vice News (Jan. 2020); NBC News (Nov. 2019); Reuters (Nov. 2018);*

Last updated: September 13, 2022