

Onur VAROL

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Center for Complex Network Research at Northeastern University
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RESEARCH INTERESTS

My research focuses on developing techniques to analyze **online behaviors** to improve **individual well-being** and address **societal problems** using online data. I leverage online and offline data to gain insight on human behaviors, analyze technological systems to mitigate threats against online conversations by developing techniques in **machine learning**, **network science**, and **computational social sciences**.

APPOINTMENTS

Sabanci University, Istanbul, Turkey

Assistant Professor, Faculty of Engineering and Natural Sciences, Computer Science and Engineering (January 2021, —)

Faculty Member, Center of Excellence in Data Analytics (January 2021, —)

Northeastern University, Boston, Massachusetts, USA

Postdoctoral Researcher, **Center for Complex Network Research** (July 2017, July 2020)

NSF I-Corps Site Fellow, Center for Entrepreneurship Education (January 2019, May 2019)

Indiana University, Bloomington, Indiana, USA

Teaching Assistant (December 2017, May 2017)

Research Assistant (August 2012, December 2017)

EDUCATION

Indiana University, Bloomington, Indiana, USA

Ph.D., Informatics, Complex Systems Track and minor in Statistics, (June 2017)

Dissertation: Analyzing Social Big Data to Study Online Discourse and its Manipulation

Awarded for University Distinguished Ph.D. Dissertation Award for 2018 in the Social Sciences

Committee: Filippo Menczer, Alessandro Flammini, Yong-Yeol Ahn, Christine Ogan, Weihua An

Koç University, Istanbul, Turkey

M.Sc., Computer Science and Engineering, (July 2012)

Thesis: Modal analysis of Myosin II and Identification of Functionally Important Sites

Advisors: Deniz Yuret, Alkan Kabakçioğlu

Istanbul Technical University, Istanbul, Turkey

B.Sc., Electronics Engineering, (June 2010)

B.Sc., Physics Engineering, (June 2012)

WORK EXPERIENCE

Data science consultant

I worked on various data science projects to support business intelligence, predictive analytics, and knowledge discovery by building machine learning pipelines, developing web platforms, and providing descriptive analysis and KPI reports. I was also a NSF I-Corps Site Fellow of the program organized by Center for Entrepreneurship Education at Northeastern University to receive training on transferring lab-based research to industry.

Microsoft Research, Redmond WA, USA

Research Intern (June 2015 - September 2015): I worked in the CLUES group at MSR. I studied social media timelines of individuals to detect experiential activities and analyzed outcomes of those actions. This project involved analyzing search query logs and social media timelines.

Microsoft Research, Redmond WA, USA

Research Intern (June 2014 - September 2014): I worked in the CLUES group at MSR. I studied how individuals in social networks adopt their behaviors to match with their inner intents. I carried out experiments on Amazon Mechanical Turk platform to justify our hypothesis at the micro level and analyzed Twitter data to validate effects at the macro level.

Stonefish Software Consultant, Istanbul, Turkey

Software Developer (August 2009 - March 2010): I worked on an enterprise web application development using C#, ASP.NET, and MSSQL.

HONORS AND AWARDS

Invited to attend and received travel support (800€) for the 7th Heidelberg Laureate Forum
 Invited to attend and full travel support for the Microsoft Research AI Breakthroughs event, 2018
 University Distinguished Ph.D. Dissertation Award for Indiana University 2018 in the Social Sciences
 Fragile Families Challenge top scoring submission for progress prize
 Best paper award at Web Science Conference, 2014
 Best poster award at Conference on Complex Systems, 2015
 Research Assistantship Indiana University (2012-2016)
 Scholarship from TUBITAK (equivalent of NSF in Turkey) (2010-2012)
 Graduate scholarship from Koç University (2010-2012)
 Chamber of Electrical Engineers (EMO) Undergraduate Project Competition 1st place (2010)
 Bosch Scholarship for Undergraduate Education (2009)
 Istanbul Technical University Student Council Vice President (2009)
 Travel grants: SIGWEB for WebSci'16 (750\$), ICWSM'16 (350\$), ACM for COSN'14 (1,500\$), IU RKCSI for INFORMS'16 (500\$)

PUBLICATIONS GOOGLE SCHOLAR CITATIONS: 3,370 H-INDEX: 16 I10-INDEX: 18

Journal Articles

- J.14 Fragile Families Challenge Team **“Measuring the predictability of life outcomes with a scientific mass collaboration”** *Proceedings of the National Academy of Sciences*, 117.15: 8398-8403, 2020
- J.13 O. Varol, I. Uluturk **“Journalists on Twitter: Self-branding, Audiences, and Involvement of Bots”** *Journal of Computational Social Science*, 1-19, 2019
- J.12 X. Wang, B. Yucesoy, O. Varol, T. Eliassi-Rad, AL. Barabasi **“Success in Books: Predicting Book Sales Before Publication”** *EPJ Data Science* 8.1: 31, 2019
- J.11 Yang K., Varol O., Davis C., Ferrara E., Flammini A., Menczer F. **“Arming the public with AI to counter social bots”** *Human Behavior and Emerging Technologies*, 1(1), 48-61, 2019
- J.10 R. Fan, O. Varol, A. Varamesh, A. Barron, I. Leemput, M. Scheffer, J. Bollen **“The minute-scale dynamics of online emotions reveal the effects of affect labeling”**, *Nature Human Behavior*, 3.1: 92, 2019
- J.9 C. Shao, GL Ciampaglia, O. Varol, K. Yang, A. Flammini, F. Menczer **“The spread of low-credibility content by social bots”**, *Nature Communications* 9:4787, 2018
- J.8 O. Varol, I. Uluturk, **“Deception Strategies and Threats for Online Discussions”** *First Monday* 22(5), 2018
- J.7 O Varol, E Ferrara, F Menczer, A Flammini. **“Early Detection of Promoted Campaigns on Social Media”**. *EPJ Data Science* 6(13), 2017
- J.6 C. Ogan, O. Varol **“What is gained and what is left to be done when content analysis is added to network analysis in the study of a social movement: Twitter use during Gezi Park”**, *Information, Communication and Society* 20(8):1220-1238, 2017
- J.5 E Ferrara, O Varol, C Davis, F Menczer, A Flammini **“The Rise of Social Bots”**, *Communications of the ACM* 59(7):96-104, 2016
- J.4 Davis CA, Ciampaglia GL, Aiello LM, Chung K, Conover MD, Ferrara E, Flammini A, Fox GC, Gao X, Gonçalves B, Grabowicz PA, Hong K, Hui P, McCaulay S, McKelvey K, Meiss MR, Patil S, Peli Kankanamalage C, Pentchev V, Qiu J, Ratkiewicz J, Rudnick A, Serrette B, Shiralkar P, Varol O, Weng L, Wu T, Younge AJ, Menczer F. **“OSoMe: The IUNI observatory on social media”**, *PeerJ Computer Science* 2: e87, 2016
- J.3 V.S. Subrahmanian, A. Azaria, S. Durst, V. Kagan, A. Galstyan, K. Lerman, L. Zhu, E. Ferrara, A. Flammini, F. Menczer, R. Waltzman, A. Stevens, A. Dekhtyar, S. Gao, T. Hogg, F. Kooti, Y. Liu, O. Varol, P. Shiralkar, V. Vydiswaran, Q. Mei, T. Huang. **“The DARPA Twitter Bot Challenge”**, *IEEE Computer* 49(6), 2016
- J.2 M JafariAsbagh, E Ferrara, O Varol, F Menczer, A Flammini **“Clustering memes in social media streams”**, *Social Network Analysis and Mining* 4(237):1-13, 2014
- J.1 O. Varol, D. Yuret, B. Eрман, A. Kabakçioğlu **“Mode coupling points to functionally important residues in Myosin II”**, *PROTEINS: Structure, Function, and Bioinformatics* 82(9):1777-86, 2014

Refereed Conference Proceedings

Conferences are a main venue of research dissemination in computer science. Conference proceedings are peer-reviewed and acceptance rates for top-tier conferences range from 10-15%.

- C.14 Yang K., **Varol O.**, Hui P., Menczer F. “**Scalable and Generalizable Social Bot Detection through Data Selection**”, AAAI’20
- C.13 **Varol O.**, Davis C., Ferrara E., Menczer F., Flammini A. “**Online Human-Bot Interactions: Detection, Estimation, and Characterization**”, ICWSM’17
- C.12 Olteanu, A., **Varol, O.**, Kiciman, E. “**What Does Social Media Say about the Outcomes of Personal Experiences**”, CSCW’17
- C.11 Ferrara E., Wang W., **Varol O.**, Flammini A., Galstyan A. “**Predicting online extremism, content adopters, and interaction reciprocity**”, SocInfo’16
- C.10 **O Varol**, “**Spatiotemporal Analysis of Censored Content on Twitter**”. WebScience’16
- C.9 A Das, S Gollapudi, E Kiciman, **O Varol**, “**Information Dissemination in Heterogeneous-Intent Networks**”. WebScience’16
- C.8 E. Ferrara, **O Varol**, F Menczer, and A Flammini. “**Detection of Promoted Social Media Campaigns**”. ICWSM’16
- C.7 A Olteanu, **O Varol**, E Kiciman. “**Towards an Open-Domain Framework for Distilling the Outcomes of Personal Experiences from Social Media Timelines**”. ICWSM’16
- C.6 C Davis[†], **O Varol[†]**, E Ferrara, A Flammini, F Menczer “**BotOrNot: A System to Evaluate Social Bots**”. WWW’16 Developers Day
- C.5 **O Varol**, E Ferrara, C Ogan, F Menczer, and A Flammini. “**Evolution of online user behavior during a social upheaval**”. WebScience’14 (Best paper award)
- C.4 **O Varol** and F Menczer. “**Connecting Dream Networks Across Cultures**”. WWW 2014 workshop on “Connecting Online & Offline Life” (COOL)
- C.3 Ferrara, E., **Varol, O.**, Menczer, F. & Flammini, A. “**Traveling Trends: Social Butterflies or Frequent Fliers?**”, ACM Conference on Online Social Networks (COSN 2013)
- C.2 E Ferrara, M JafariAsbagh, **O Varol**, V Qazvinian, F Menczer, A Flammini “**Clustering Memes in Social Media**”, ASONAM 2013
- C.1 Yasemin Alban; Tuba Ayhan; **Onur Varol**; Müştak Erhan Yalçın “**A Feature Filtering Method for EEG Data Classification**”, Signal Processing and Communications Applications (SIU), IEEE 19th Conference, Antalya, April 20-22 2011.

Book chapter

- B.1 **Varol O.**, Davis C., Menczer, F., Flammini, A. “**Feature Engineering for Social Bot Detection**”, Feature Engineering for Machine Learning and Data Analytics (2018): 311.

Commentary & Editorial

- E.1 Gates AJ., Ke Q., **Varol O.**, Barabasi AL. “**Nature’s reach: narrow work has broad impact**”, Nature (2019): 32-34.

Patent

- P.1 “**Peak sale and one year sale prediction for hardcover first releases**” Yucesoy, B., Wang, X., Barabasi, A. L., **Varol, O.**, Ruppert, P., Eliassi-Rad, T. (2019). U.S. Patent Application No. 16/012,181.

Preprints & Under review

- U.4 Gysi D., Do Valle I., Zitnik M., Ameli A., Gan X., **Varol O.**, Sanchez H., Baron R., Ghiasian D., Loscalzo J., Barabasi AL. “**Network Medicine Framework for Identifying Drug Repurposing Opportunities for COVID-19**”, ArXiv:2004.07229
- U.3 M. Sayyadiharikandeh, **O. Varol**, K. Yang, A. Flammini, F. Menczer “**Detection of Novel Social Bots by Ensembles of Specialized Classifiers**”
- U.2 X. Wang, **O. Varol**, T. Eliassi-Rad “**L2P: Learning to Place for Estimating Heavy-Tailed Outcomes**”, ArXiv:1908.04628
- U.1 Hui, P.K., Yang, K.C., **Varol O.**, Menczer F. “**Election Impersonators: Abusing the Right to Be Forgotten**”

Research Projects

DOISAC: Project name stands for “Detecting Orchestrated Information and Synthetic Account Campaigns”. This project founded by the Office of Naval Research aims at detecting orchestrated information and synthetic activity campaigns on social media using machine learning and computational tools. In this project, I studied individual and group activities of terrorist recruiters. We build predictive models to identify accounts with malicious intentions and activities.

PIs: [Emilio Ferrara](#), [Alessandro Flammini](#),

DESPIC: Project name stands for “Detecting Early Signature of Persuasion in Information Cascades” and aims to design a system detect persuasion campaigns at their early stage of inception, in the context of online social media. Our team built a system that analyzes social media data and extracts network, temporal, content, and user-based features to detect online campaigns. I worked on several modules of this framework: (i) a clustering procedure that uses metadata to compute similarity between memes; (ii) a classification system that determines whether a meme is potentially an orchestrated campaign or a genuine, grassroots conversation; (iii) a social bot detection framework called BotOrNot. This project founded by DARPA SMISC program.

PIs: [Alessandro Flammini](#), [Filippo Menczer](#)

Truthy: This project aims to understand how information propagates through complex socio-technical information networks. In this project, I analyzed and studied roles of individuals during social upheavals, diffusion of trending topics in spatio-temporal space, and characterization of social media censorship and its effect on user behavior.

PIs: [Alessandro Flammini](#), [Filippo Menczer](#)

Teaching Experience

Northeastern University, Boston MA, USA

Algorithms that Affect Lives (Guest Lecturer, Fall 2020)

Unsupervised Machine Learning and Data Mining (Guest Lecturer, Fall 2019)

Data Mining Techniques (Guest Lecturer, Spring 2019 and Fall 2018)

Indiana University, Bloomington IN, USA

Topics in Informatics: Performance Analytics (Teaching Assistant, Spring 2017)

Koç University, Istanbul, Turkey

Machine Learning (Teaching Assistant, Spring 2012)

Microprocessors (Teaching Assistant, Fall 2011)

Probability and Random Variables (Teaching Assistant, Spring 2011)

Discrete Mathematics (Teaching Assistant, Fall 2010)

Mentoring

Northeastern University, Boston MA, USA

Xindi Wang (NetSI Phd student, [Spring 2017,—])

Sarthak Kothari (Data science MSc. student, [Summer 2019, Spring 2020])

Omair Ahmed (Data science MSc. student, [Fall 2019, Spring 2020])

Indiana University, Bloomington IN, USA

Mohsen Sayyadi (Computer Science PhD student, [Spring 2018,—])

Kaicheng Yang (Informatics PhD student, [Spring 2017,—])

Zoher Kachwala (Computer Science MSc student, Spring 2018)

Shradha Baranwal (Computer Science MSc student, Spring 2018)

Organized Workshops

- Workshop on *Misinformation and Social Bots* at the 7th Heidelberg Laureate Forum (09/23/2019)

Invited Talks

- Modeling individual and group behavior in complex interactive systems, The University of Edinburgh, Scotland (Teleconference, 2020/03/30)
- Modeling individual and group behavior in complex interactive systems, Aalto University, Finland (Teleconference, 2020/03/16)
- Modeling individual and group behavior in complex interactive systems, Vanderbilt University, USA (2020/02/12)

- Modeling individual and group behavior in complex interactive systems, Bilkent University, Turkey (2019/10/08)
- Modeling individual and group behavior in complex interactive systems, Sabanci University, Turkey (2019/10/03)
- Modeling individual and group behavior in complex interactive systems, Kadir Has University, Turkey (2019/10/02)
- Modeling individual and group behavior in complex interactive systems, Koc University, Turkey (2019/10/01)
- Modeling individual and group behavior in complex interactive systems, University of Pittsburgh School of Computing and Information (2019/04/17)
- Detecting Social Bots and Modeling Online Behavior, Microsoft Research AI Breakthroughs, Redmond, USA (2018/09/17)
- Observatory of Social Media, Exploring Media Ecosystems Conference at MIT Media Lab (2017/03/06)
- Predicting adolescence academic performance through panel survey data, Fragile Families Challenge Scientific Workshop at Princeton University (2017/11/17)
- Observatory on Social Media: Investigating Bots and Disinformation, Digital Disinformation Forum Stanford (2017/06/26)
- The Impact of Censorship on Tweeting Behaviors, Indiana University Conference on Big Data and Network Science (2017/03/23)
- Studying Individuals and Groups using Online Data, Northeastern University Network Science Institute (2017/03/09)
- Analysis of Online Discourse and Information Diffusion, INFORMS Meeting Nashville (2016/11/15)
- Detection of Online Manipulation, UND Big Data Summit Event (2016/04/07)
- Twitter Applications: Industry Panel Speaker, UND Big Data Summit Event (2016/04/07)
- Campaign and Social Bots Detection on Social Networks, Workshop in Network Science (WINS) Indiana University (2016/02/18)
- Evolution of online user behavior during a social upheaval, Indiana University Turkish Flagship Center (2015/01/21)
- Studying Social Dynamics Through Social Media, Istanbul Technical University Physics Department Colloquia (2014/04/28)

Conference Presentations

- Journalists on Twitter: Self-branding, Audiences, and Involvement of Bots, Politics and Computational Social Science, Washington, DC. USA (2019-08-28)
- Detection, Estimation, and Characterization of Bot Nodes in Social Networks, Network Science Conference, Indianapolis USA (2017-06-21)
- Distilling the Outcomes of Personal Experiences from Social Media Timelines, International Conference on Computational Social Science, Evanston Illinois USA (2016-06-25)
- Information Dissemination in Heterogeneous-Intent Networks, Web Science Conference, Hannover Germany (2016-05-24)
- Evolution of Online User Behavior During Social Upheaval, Conference on Complex Systems (CCS), Tempe Arizona USA (2015-09-27)
- Connecting Dream Networks Across Cultures, COOL Workshop at World Wide Web (WWW) Conference, Seoul Korea (2014-04-08)

Turkish Outreach

- Sosyal Medyanin Problemleri, epiSTEM Türkiye Youtube Live youtube.com/watch?v=Mzjf7r6F5mQ (2020-05-03)

COMPUTER AND LANGUAGE SKILLS

Programming Languages and Skills:

Frequent user of Python for data analysis using Matplotlib, NetworkX, Pandas, Scikit-learn, etc. Experience in \LaTeX , C / C++, C#, Java, MATLAB, R, OpenBUGS
Familiar with HTML, CSS, JS for frontend, Flask, Django, and ASP.NET for larger applications
Used MySQL, NoSQL (CouchDB and Riak), Map-Reduce
View projects on Github: github.com/onurvarol

Languages: English (fluent), German (beginner), Turkish (native)

Grant panels and ad-hoc reviews: ERC Starting Grant (2020), Bar Ilan Cyber Security Center (2019)

Editorial boards: Technical committee member for Online Social Networks and Media (OSNEM); Editorial board member of Human Behavior & Emerging Technologies (HBET); Guest editor for Applied Network Science Special Issue on Epidemics, Dynamics & Control on Networks

Conference organizing committee: IC2S2'20 Publication Chair

Satellite co-organizer: Quantifying Success (NetSci'20)

Workshop co-organizer: Open Science for an Open Society (CCS'16)

Journal reviewer: Nature Scientific Reports; Nature Machine Intelligence; Communications of the ACM; EPJ Data Science; PLoS One; Network Science; Social Networks; Social Network Analysis and Mining; Communications Physics; Journal of Computational Social Sciences; Information, Communication and Society; PeerJ-CS; ACM Transactions on Social Computing; ACM Transactions on the Web; IEEE Transactions on Knowledge and Data Engineering; IEEE Access; IEEE Intelligent Systems; IEEE Communications Magazine; Big Data; First Monday; Journal of Medical Internet Research; Journal of the Royal Society Interface; Patterns; Computers in Human Behavior; Data Mining and Knowledge Discovery; Information; Online Information Review; Social Science Research; Social Science Computer Review; Online Social Networks and Media; Applied Network Science; International Journal of Information Management; International Journal of Public Opinion Research

Journal subreviewer: Science Advances; Nature Communications

Conference Senior PC member: HyperText'18; ICWSM'20

Conference PC member: WWW'17-'20; WSDM'19/'20; ICWSM'17-'20; KDD'19; SDM'19; WebSci'18/'19/'20; CHI'18; CSCW'18/'19; CompleNet'18; NetSci'17-'20; NetSciX'20; SocInfo'17-'20; IC2S2'17-'20; ICCS'20; HyperText'17/'18/'19; DSAA'17/'18/'19

Workshop PC member: IEEE BigData'17/'18; SIGIR Demo'18;

Conference subreviewer: ICWSM'15; IC2S2'15; ASONAM'15; WebScience'14

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