Alexander J. Gates

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Academic Positions

University of Virginia
School of Data Science

- Assistant Professor of Data Science — 2022 to present

Northeastern University
Department of Sociology & Anthropology

- Associate Research Scientist — 2021 to 2022

Northeastern University
Network Science Institute

- Affiliated Researcher — 2021 to present
- Associate Research Scientist — 2019 to 2021
- Post-doctoral Research Associate — 2017 to 2019

Education

Ph.D. *Informatics (Networks & Complex Systems)* joint with *Cognitive Science* — May 2017
Indiana University (Bloomington, Indiana, USA) GPA: 3.985 / 4.0

- Thesis topic: Anatomical and Effective Structure of Complex Systems
- Advisers: Professors Yong-Yeol Ahn, Randall D. Beer, Luis M. Rocha

M.Sc. with distinction: *Mathematical Modelling for Complex Systems* — January 2012
King's College London (London, United Kingdom)

B.A. *Mathematics* — May 2009
Cornell University (Ithaca, New York, USA)

Publications

🎓 Google Scholar Profile
ⓘD ORCID Profile

Work in progress

P8. **Gates, A. J.**, Mane, I. & Barabasi, A.-L. (in prep.) Networks of national citation preference

P7. **Gates, A. J.**, Ke, Q. & Barabasi, A.-L. (in prep.) "The peerless genius?": A quantitative comparison of scientific excellence

P6. Fraser, T., & **Gates, A. J.**, Nelson, L., Zippel, K. (in prep.) Bottom-up or Top-Down? Bridging academics in the ADVANCE network for gender equity

P5. Grudt, R., Zippel, K. & **Gates, A. J.** (in prep.) Quantifying the impact of NSF ADVANCE Grants on Recipients' Careers

Preprints, work in submission

P4. Wang, X., **Gates, A. J.** & Barabasi, A.-L. (in sub.) The science of success

P3. **Gates, A. J.** & Barabasi, A.-L. (in sub.) Reproducible science of science at scale: pySciSci
⌂ Code on: **Github**

P2. Shekhtman, L. **Gates, A. J.** & Barabasi, A.-L. (in sub.) Mapping philanthropy in science

P1. Wang, X., **Gates, A. J.**, Resch, M. & Barabasi, A.-L. (in sub.) Quantifying systemic gender inequality in art

Peer Reviewed
[†]: equal contribution

J14. Gold, J.[†], **Gates, A. J.**[†], Arefinul, S., Melson, M., Nelson, L. K. & Zippel, K. (2022) The NSF ADVANCE network of organizations. **ADVANCE Journal** 3 (1) https://doi.org/10.5399/osu/ADVJRNL.3.1.3

J13. **Gates, A. J.**, Correia, R. B., Wang, X., & Rocha, L. M. (2021) The effective graph reveals redundancy, canalization, and control pathways in biochemical regulation and signaling. **Proc. Natl. Acad. Sci. USA (PNAS)** 118 (12), e2022598118 (cover story, see M4)
⌂ Code on: **Github**
Commentaries and Press coverage:
  – **PNAS** "Identifying 'more equal than others' edges in diverse biochemical networks"
  – **Gulbenkian Science** "Uncovering the 'master switches' of biochemical networks can explain the effects of drugs in the destruction of cancer cells"
  – **Publico** (in portuguese) "Criado modelo que distingue principais interaccoes de genes com organismo"
    Reprinted: **SIC Noticias**, **Health News**, **Jornal Economico**, **RTP Noticias**, **Lifestyle ao minuto**, **Destak**, **Sabado**, **Observador**, **Porto Canal - Sapo (Online)**, **Saude Mais tv (online)**

J12. **Gates, A. J.**[†], Gysi, D. M.[†], Kellis, M. & Barabasi, A.-L. (2021) A wealth of discovery built on the Human Genome Project–by the numbers. **Nature** 590, 212-215 (cover story, see M3)
Press coverage:
  – **Mashup MD** "A wealth of discovery built on the Human Genome Project — by the numbers"
  – **News Break** "A wealth of discovery built on the Human Genome Project — by the numbers"
  – **American Online News** "A Wealth Of Discovery Built On The Human Genome Project — By The Numbers – Nature.Com"

J11. Huang, J.[†], **Gates, A.J.**[†], Sinatra, R. & Barabasi, A.-L. (2020) Historical comparison of gender inequality in scientific careers across countries and disciplines. **Proc. Natl. Acad. Sci. USA (PNAS)** 117 (9), 4609-4616
Commentaries and Press coverage:
  – **PNAS** "Do the social roles that women and men occupy in science allow equal access to publication?"
  – **Nature Index** "Women rival men in scientific research publications and citations"
  – **Inside Higher Education** "Gender Inequality in Science Careers and Publishing"
  – **Diverse News** "Study: Gender Inequality Persists in Science Careers and Publishing"
  – **Chemical & Engineering News** "Women publish at rates equal to men but leave science earlier"
  – **Drug Target Review** "Gender inequality in STEM publishing due to female dropout rates, says study"
  – **Science Nordic** "Women are not formally discriminated against in Norwegian academia but they still dont become professors"
  – **The Paper** (in chinese)
  – **News@Northeastern** "Do women publish less than men in scientific fields? Turns out, scientists have been asking the wrong question."

J10. **Gates, A. J.**, Ke, Q., Varol, O. & Barabasi, A.-L. (2019) Nature's reach: narrow work has broad impact. **Nature** 575, 32-34 (cover story, see M1)

Press coverage:
- **Fast Company** "This mesmerizing 3D map visualizes millions of scientific studies"
- **InfoDocket** "A Network of Science: 150 Years of Nature Papers"
- **ICMAB** "A network of science: 150 years of Nature papers"
- **Hungarian Insider** "Hungarian helps Nature magazine celebrate 150th anniversary"
- **News@Northeastern** "150 years of science in a cosmic web of paper trails"

J9. **Gates, A. J.**, Wood, I. B., Hetrick, W. P & Ahn, Y.-Y. (2019) Element-centric clustering comparison unifies overlaps and hierarchy. **Scientific Reports** 9, 8574
 Code on: **Github**

J8. **Gates, A. J.** & Ahn, Y.-Y. (2019) CluSim: a python package for calculating clustering similarity. **Journal of Open Source Software** 4, 1264
 Code on: **Github**

J7. Correia, R. B., **Gates, A. J.**, Wang, X. & Rocha, L.M. (2018) CANA: A Python Package for Quantifying Control and Canalization in Boolean Networks. **Frontiers in Physiology** 9, 1046
 Code on: **Github**

J6. **Gates, A. J.** & Ahn, Y.-Y. (2017) Impact of Random Models on Clustering Similarity. **Journal of Machine Learning Research** 18, 1-28

J5. Agmon, E., **Gates, A. J.** & Beer, R. D. (2016) The structure of ontogenies in a model protocell. **Artificial life** 22, 1-19

J4. Agmon, E., **Gates, A. J.**, Churavy, V. & Beer, R. D. (2016) Exploring the space of viable configurations in a model of metabolism-boundary co-construction. **Artificial life** 22, 153-171

J3. **Gates, A. J.** & Rocha, L.M. (2016) Control of complex networks requires both structure and dynamics. **Scientific Reports** 6, 24456
 Code on: **Github**

Press coverage:
- **Money Science** "Control of complex networks requires both structure and dynamics"

J2. Kolchinsky, A., **Gates, A. J.** & Rocha, L. M. (2015) Modularity and the spread of perturbations in complex dynamical systems. **Physical Review E** 92, 060801

J1. Das, S., **Gates, A. J.**, Abdu, H. A., Rose, G. S., Picconatto, C. A. & Ellenbogen, J. C. (2007) Designs for ultra-tiny, special-purpose nanoelectronic circuits. **IEEE: Circuits and Systems I**, 54, 2528-2540

Peer Reviewed Conference Proceedings

C3. Agmon, E., **Gates, A. J.** & Beer, R. D. (2015) Ontogeny and adaptivity in a model protocell. **Proceedings of the European Conference on Artificial Life (ECAL'15)**. 216-223. York, UK.

C2. Agmon, E., **Gates, A. J.**, Churavy, V. & Beer, R. D. (2014) Quantifying robustness in a spatial model of metabolism-boundary co-construction. **Proceedings of the International Conference on Artificial Life (ALife'14)**. 514-521. NYC, USA.

C1. **Gates, A. J.** & Rocha, L. M. (2014) Structure and dynamics affect the controllability of complex systems: a preliminary study. **Proceedings of the International Conference on Artificial Life (ALife'14)**. 429-430. NYC, USA.

Other Works

O1. Macdonald, B. & **Gates, A. J.** (2020) Experts' Commentary: The Soccer Team Problem. **The UMAP Journal** 41(3): 257-260

MULTIMEDIA
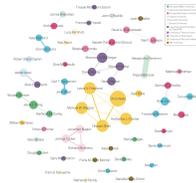PROJECTS

M1. **Nature 150th anniversary**   2019
Depicting the interconnected history of a scientific journal.

1) Cover visualization
2) Animated movie
3) 3D interactive network visualization

🏆 **Awards**: 2020 Webby Award; 2020 Peoples Voice Webby Award;
Fast Company's 2020 Innovation by Design finalist in the Data Design category;
2020 European Design Gold Medal; Places & Spaces featured work; Ludwig Museum: Hidden Patterns featured work

M2. **Knight Research Network Assessment**   2021,2022
Visualization and analysis of the Knight Research Network (KRN).

Network visualizations and analysis (pages 13-16)

M3. **Impact of the Human Genome Project**   2021
Visualization and analysis of scientific attention to the Human Genome.

1) Cover visualization
2) Animated movie

M4. **Biochemical network visualization**   2021
Visualization and analysis of biochemical singalling networks.

Cover visualization

GRANTS	**Contributed**

G3. **National Science Foundation**, NSF # 2000713   2020-2023
Innovation Networks: The Creation and Diffusion of Gender Equity Ideas in Universities
Role: Senior Scientific Advisor and Research Scientist
PIs: Kathrin Zippel & Laura Nelson
USD **1,400,000**

G2. **The Air Force Office of Scientific Research**, Minerva Award   2019-2024
Understanding fundamental dynamics, predictabilities, and uncertainties of scientific discovery
Role: Wrote Northeastern contribution and Lead Northeastern team
PIs: Dashun Wang, Brian Uzzi, Benjamin Jones, Luis Amaral, James A. Evans, Santo Fortunato & Albert-Laszlo Barabasi
USD **1,500,000**

G1. **Templeton Foundation**   2018-2021
Using Big Data to Quantify & Cultivate Genius
Role: Wrote the grant and assumed Project Lead, coordinating the research contributions of 2 post-docs, 2 doctoral students, and 8 masters students
PI: Albert-Laszlo Barabasi
USD **2,000,000**

PRESENTATIONS   **Invited conference talks and lectures**

I1. Life Science Across the Globe (LSAG)   2022
"The importance of data for Gender Policy in Science"

I2. NetSci-X 5th Intl. Conference and School on Network Science (Tokyo, Japan) 2020
"How to find Network Communities and what to do with them"

I3. University of Oklahoma (Norman, Oklahoma)   2018
"Visual analytics for network resilience"

Contributed Talks

- Complex Networks 2020 (Madrid, Spain)   2020
  "The effective graph reveals redundancy, canalization,
  and control pathways in biochemical regulation and signaling"
- International Conference on Network Science (Burlington, VT)   2019
  "The effective graph captures canalizing dynamics and control in
  Boolean network models of biochemical regulation"
- International Conference on Network Science (Indianapolis, IN)   2017
  "On comparing clusterings: an element-centric framework unifies
  overlaps and hierarchy"
- Advanced Computational Neuroscience Network (Ann Arbor, MI)   2016
  "Comparing the multi-scale structure of human connectomes"
- Conference on Complex Systems (Tempe, AZ)   2015
  "Control of complex networks requires structure and dynamics"
- International Conference on Artificial Life (New York, NY)   2014
  "Structure and dynamics affect the controllability of complex systems:
  a preliminary study"
- Workshop on Very Small Robots (McLean, VA)   2005
  "Designs for ultra-tiny, special-purpose nanoelectronic circuits"

WORKSHOPS

Datathon 4 Justice	2021
Science of Science Summer School	2021
Complex Networks Winter Workshop	2021
Summer School on Stat. Inference & Info. Theory in Complex Systems	2012

TEACHING

Instructor of Record, Indiana University Bloomington

I201 Mathematical Foundations of Informatics	Spring 2017
I201 Mathematical Foundations of Informatics	Fall 2016
I201 Mathematical Foundations of Informatics	Spring 2016
I201 Mathematical Foundations of Informatics	Fall 2015

Associate Instructor, Indiana University Bloomington

I201 Mathematical Foundations of Informatics, Honors	Spring 2012
I201 Mathematical Foundations of Informatics	Fall 2011

Instructor of Record, Cornell University

BTRY 115 Intro To Quantitative Methods	Spring 2009
BTRY 115 Intro To Quantitative Methods	Spring 2008

Teaching Assistant, Cornell University

Math 012 Calculus	Spring 2009
Math 011 Calculus	Fall 2008
Math 012 Calculus	Spring 2008
Math 011 Calculus	Fall 2007
Prefreshman Mathematics Summer Program	Summer 2007

ADVISING

PhD Students

Yessica Herrera, Universidad del Desarrollo, Chile	2021-present
Charles Levine, Maj. US Army, Northeastern University, USA	2019-present
Xindi Wang, Northeastern University, USA	2019-present
Milan Janosov, Central European University, Hungary	2019

Masters Students - Thesis

Rachael Grudt	2020-2021

Masters Students - Project

Indraneel Sunil Mane	2019-2021
Ashutosh Singh, Trevor Pearce	2020
Xinyu Tang, Apoorva Kasoju, Sreejith Sreekumar	2019

Undergraduate Students

Kristen Flaherty	2019

INDUSTRIAL
POSITIONS

MITRE

Student Intern in the Nanosystems Group	2006
Student Intern in the Nanosystems Group	2004

HONORS

Visualization & Communication

• Webby Award	2020
• Peoples Voice Webby Award	2020
• Fast Company's Innovation by Design finalist in the Data Design category	2020

- European Design Gold Medal   2020

Conference

- Best Paper, European Conference on Artificial Life (York, UK)   2015
- Best Poster, IGERT Research Showcase (Bloomington, Indiana, USA)   2014
- Best Poster, IGERT Research Showcase (Bloomington, Indiana, USA)   2013
- MITRE Best Technical Paper Runner-Up (McLean, Virginia, USA)   2007
- Semi-Finalist, Intel Science Talent Search   2005
- State Finalist, Junior Science and Humanities (New York, USA)   2005

Scholarship

- Trainee, NSF/IGERT Brain Body Environment, Indiana University   2012-2015
- Thomas J. Watson Scholar, IBM   2005-2009

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Departmental Service

- *CCNR Journal Club*, Northeastern University   2017-2019
  organize a biweekly meeting of post-docs to discuss recent literature
- *Complex CopyCats*, Indiana University   2013-2016
  founder and lead organizer of this reading group focused on
  reproducing results from important complexity science papers
- *Graduate Program Committee*, Indiana University   2013-2015
  student representative with focus on curriculum development,
  degree requirements, and admissions
- *Graduate Informatics Student Association (GISA)*, Indiana University   2013-2015
  co-founder and institutional voice chair

International Service

- *Interdisciplinary Contest in Modeling*   2019-2021
  An international contest for 20,000 undergraduate students.
  Authored the Network Science Problem ('20), triage grading ('19-'21),
  final grading ('20-'21), and authored a problem perspective [O1].
  See this article about the 2020 winning team: William & Mary, News & Media.

Conference Organization

- Program Committee, *Complex Networks and their Applications 2022* (Palermo, Italy).
  November 2022
- Program Committee, *NetSci-X 2022* (Porto, Portugal).   February 2022
- Program Committee, *Complex Networks and their Applications 2021* (Madrid, Spain).
  November 2021
- Satellite Organizer, *Quantifying Success* (Virtual).   July 2021
- Program Committee, *Complex Networks 2020* (Madrid, Spain).   December 2020
- Satellite Organizer, *Quantifying Success* (Rome, Italy).   September 2020
- Program Committee, *NetSci 2020* (Rome, Italy).   September 2020
- Program Committee, *NetSci-X 2020* (Tokoyo, Japan).   January 2020
- Program Committee, *Complex Networks 2019* (Lisbon, Portugal).   December 2019
- Poster Session Co-chair, *CompleNet 2018* (Boston, MA).   March 2018

Reviewer

- **Funding**: National Science Foundation (NSF, SoS:DCI, 2019, 2021 & 2022)
- **General**: *Proc. Natl. Acad. Sci. U.S.A* (PNAS); *Nature Communications*; *Scientific Reports*

- **Data Science**: *EPJ Data Science; Applied Network Science; Transactions on Knowledge Discovery in Data; Pattern Recognition; WIRES Computational Statistics; Data Mining and Knowledge Discovery; Patterns*
- **Computer Science**: *PeerJ Computer Science; Innovations in Theoretical Computer Science Conference (ITCS 2022); IEEE Access; IEEE Transactions on Fuzzy Systems; Journal of Open Source Software; IEEE Signal Processing Letters; Engineering Optimization*
- **Social Sciences**: *Quantitative Science Studies; Intelligent Systems in Accounting, Finance and Management*
- **Physics**: *Physical Review X; Physical Review E; Chaos; Nature Communications Physics*
- **Computational Biology**: *Nature Neuroscience; Proceedings of the Royal Society B; Bioinformatics; Nucleic Acids Research; Artificial Life*