

# Luiz G. A. Alves

Postdoctoral Fellow at Northwestern University

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**Research interests**

- Data Science
- Machine Learning
- Complex Networks
- Complex Systems
- Statistical Physics

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**Education**

<b>State University of Maringá</b> PhD in Physics Thesis: Scale invariance and anomalous diffusion in urban and biological complex systems Advisor: Professor Haroldo V. Ribeiro.	Maringá - PR, Brazil Mar./2014 – Mar./2017
<b>State University of Maringá</b> MSc in Physics Thesis: Statistical and dynamical patterns in homicides and urban metrics Advisor: Professor Renio S. Mendes. Co-advisor: Professor Haroldo V. Ribeiro.	Maringá - PR, Brazil Mar./2013 – Mar./2014
<b>State University of Maringá</b> BSc in Physics Thesis: Computer simulation of complex systems Advisor: Professor Renio S. Mendes.	Maringá - PR, Brazil Mar./2009 – Dec./2012

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**Research experience**

<b>Northwestern University</b> Postdoctoral fellow at McCormick School of Engineering Advisor: Professor Luis A. Nunes Amaral.	Evanston - IL, USA Nov./2018 – present
<b>University of São Paulo</b> Postdoctoral fellow at Inst. of Math. and Computer Sciences Advisor: Professor Francisco A. Rodrigues.	São Carlos - SP, Brazil Apr./2017 – Oct./2018
<b>State University of Maringá</b> Graduate researcher assistant at Department of Physics Advisors: Professors Renio S. Mendes and Haroldo V. Ribeiro.	Maringá - PR, Brazil Mar./2013 – Mar./2017
<b>Northwestern University</b> Visiting Scholar at McCormick School of Engineering Advisor: Professor Luis A. Nunes Amaral.	Evanston - IL, USA Nov./2015 – Oct./2016
<b>State University of Maringá</b> Undergraduate researcher assistant at Department of Physics Advisor: Professor Renio S. Mendes	Maringá - PR, Brazil Feb./2010 – Jan./2013

<b>Awards and fellowships</b>	Data Science Consortium (University of Michigan)	2019
	The Best of the Physics arXiv (MIT Review of Technology)	January 20, 2018
	Postdoctoral fellowship (FAPESP)	Apr./2017 – Oct./2018
	Doctoral fellowship (CAPES)	Nov./2016 – Mar./2017
	Visiting scholar fellowship (CAPES)	Nov./2015 – Oct./2016
	Doctoral fellowship (CNPq)	Mar./2014 – Oct./2015
	Master fellowship (CAPES)	Mar./2013 – Feb./2014
	Undergraduate research fellowship (CNPq)	Feb./2010 – Jan./2013
<b>Work in progress</b>	1. <b>LGA Alves</b> , CRA Alves, AR Pah, J Hagan, LAN Amaral, Changes in poverty and ethnic diversity predict the murder rate of U.S. metropolitan statistical areas over a 55-year period. In preparation (2021).	
	2. <b>LGA Alves</b> , G Mangioni, FA Rodrigues, P Panzarasa, Y Moreno, The rise and fall of countries in the global value chains. In preparation (2021).	
<b>Publications</b>	1. W Lei, <b>LGA Alves</b> , LAN Amaral, Forecasting the evolution of transportation networks using machine learning. Under review in Nature Communications (2021).	
	2. <b>LGA Alves</b> , BR da Cunha, FA Rodrigues, P Panzarasa, Topological and weighted rich-club effects in corruption networks. Under review in Journal of Quantitative Criminology (2021).	
	3. <b>LGA Alves</b> , D. Rybski, HV Ribeiro, Commuting network effect on urban wealth scaling. Accepted for publication in Scientific Reports (2021).	
	4. HA Lee*, <b>LGA Alves</b> *, LAN Amaral, Spreader events and the limitations of projected networks for capturing dynamics on multipartite networks. Physical Review E 103, 022320 (2021). * Equal contribution.	
	5. <b>LGA Alves</b> , HYD Sigaki, M Perc, HV Ribeiro, Collective dynamics of stock market efficiency, Scientific Reports 10, 21992 (2020).	
	6. <b>LGA Alves</b> , A Aleta, FA Rodrigues, Y Moreno, LAN Amaral, Centrality anomalies in complex networks as a result of model over-simplification. New Journal of Physics 23, 013043 (2020).	
	7. GS de Souza, ACPLF de Carvalho, JF Rodrigues-Jr, <b>LGA Alves</b> , Reconstructing commuters network using machine learning and urban indicators. Scientific Reports 9, 11801 (2019).	
	8. <b>LGA Alves</b> , G Mangioni, I Cingolani, FA Rodrigues, P Panzarasa, Y Moreno, The nested structural organization of the worldwide trade multi-layer network. Scientific Reports 9, 2866 (2019).	
	9. <b>LGA Alves</b> , JS Andrade, Quentin S. Hanley, HV Ribeiro. The hidden traits of endemic illiteracy in cities. Physica. A 515, 566-574 (2019).	
	10. <b>LGA Alves</b> , G Mangioni, FA Rodrigues, P Panzarasa, Y Moreno, Unfolding the complexity of the global value chain: Strengths and entropy in the single-layer, multiplex, and multi-layer international trade networks. Entropy 20, 909 (2018).	
	11. <b>LGA Alves</b> , HV Ribeiro, FA Rodrigues, Crime prediction through urban metrics and statistical learning, Physica A 505, 435–443 (2018).	
	12. HV Ribeiro, <b>LGA Alves</b> , AF Martins, EK Lenzi, M Perc, The dynamical structure of political corruption networks, Journal of Complex Networks CNY002 (2018).	
	13. <b>LGA Alves</b> , PB Winter, LN Ferreira, RM Brielmann, RI Morimoto, LAN Amaral, Long-range correlations and fractal dynamics in <i>C. elegans</i> : changes with aging and stress. Physical Review E 96, 022417 (2017).	

14. **LGA Alves**, DB Scariot, RR Guimarães, CV Nakamura, RS Mendes, HV Ribeiro, Transient superdiffusion and long-range correlations in the motility patterns of trypanosomatid flagellate protozoa, *PLoS ONE* 11, e0152092 (2016).
15. AC Braga, **LGA Alves**, LS Costa, AA Ribeiro, MMA Jesus, AA Tateishi, HV Ribeiro, Characterization of river flow fluctuations via horizontal visibility graphs, *Physica. A* 444, 1003 (2016).
16. **LGA Alves**, RS Mendes, EK Lenzi, HV Ribeiro, Scale-adjusted metrics for predicting the evolution of urban indicators and quantifying the performance of cities, *PLoS ONE* 10, e0134862 (2015).
17. **LGA Alves**, EK Lenzi, RS Mendes, HV Ribeiro, Spatial correlations, clustering and percolation-like transitions in homicide crimes, *Europhysics Letters* 111, 18002 (2015).
18. HV Ribeiro, LS Costa, **LGA Alves**, PA Santoro, S Picoli, EK Lenzi, RS Mendes, Analogies between the cracking noise of ethanol-dampened charcoal and earthquakes, *Physical Review Letters* 115, 025503 (2015).
19. **LGA Alves**, HV Ribeiro, MAF Santos, RS Mendes, EK Lenzi, Solutions for a q-generalized Schrödinger equation of entangled interacting particles, *Physica A* 429, 35 (2015).
20. HV Ribeiro, AA Tateishi, **LGA Alves**, RS Zola, EK Lenzi, Investigating the interplay between mechanisms of anomalous diffusion via fractional Brownian walks on a comb-like structure, *New Journal of Physics* 16, 093050 (2014).
21. **LGA Alves**, HV Ribeiro, EK Lenzi, RS Mendes, Empirical analysis on the connection between power-law distributions and allometries for urban indicators, *Physica A* 409, 175 (2014).
22. HV Ribeiro, FJ Antonio, **LGA Alves**, EK Lenzi, RS Mendes, Long-range spatial correlations and fluctuation statistics of lightning activity rates in Brazil, *Europhysics Letters* 104, 69001 (2013).
23. **LGA Alves**, HV Ribeiro, EK Lenzi, RS Mendes, Distance to the scaling law: a useful approach for unveiling relationships between crime and urban metrics. *PLoS ONE* 8, e69580 (2013).
24. **LGA Alves**, HV Ribeiro, RS Mendes, Scaling laws in the dynamics of crime growth rate. *Physica. A* 392, 2672 (2013).

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### Talks and posters

1. Talk: Spreader events and the limitations of projected networks for capturing dynamics on multipartite networks, *Networks 2021 (virtual) - USA* (2021).
2. Invited Talk: Reconstructing commuters network using machine learning and urban indicators, *MIDAS Symposium - Embracing the Challenge: Data Science for the Next Ten Years - Ann Arbor - MI, USA* (2019).
3. Talk: Anomaly detection in complex networks as a diagnosis of model oversimplification, *International School and Conference on Network Science - Burlington, VT, USA* (2019).
4. Talk: Topological and weighted rich-club effect in corruption networks, *International School and Conference on Network Science - Burlington, VT, USA* (2019).
5. Talk: The nested structural organization of the worldwide trade multi-layer network, *International School and Conference on Network Science - Paris, France* (2018).
6. Poster: The dynamical structure of political corruption networks, *International School and Conference on Network Science - Paris, France* (2018).
7. Talk: Crime structure and dynamics unveiled by statistical physics and complex networks, *International School and Conference on Network Science - Paris, France* (2018).

8. Invited Talk: The dynamical structure of political corruption networks, Talk at the Federal University of São Carlos, Department of Production Engineering - São Carlos, SP, Brazil (2018).
9. Talk: Statistical physics of crime: From scaling laws to complex networks, International Conference on Complex Networks - Boston, MA, USA (2018).
10. Poster: Crime prediction through urban metrics and statistical learning, III Workshop for the ICMC Postdocs - São Carlos, SP, Brazil (2017).
11. Talk: Traffic prediction algorithm via data analysis, III Brazilian Study Group with Industry - São Carlos, SP, Brazil (2017).
12. Talk: Unveiling the structure and predicting missing links of the network of political corruption in Brazil, International School and Conference on Network Science - Indianapolis, IN, USA (2017).
13. Poster: Quantifying and predicting the performance of cities via scale-adjusted metrics, International Conference on Computational Social Science - Evanston, IL, USA (2016).
14. Poster: Empirical analysis on the connection between power-law distributions and allometries for urban indicators, European Conference on Complex Systems - Lucca, Italy (2014).
15. Talk: Distance to the scaling law: a useful approach for unveiling relationships between crime and urban metrics, European Conference on Complex Systems - Lucca, Italy (2014).
16. Poster: Scaling laws in the dynamics of crime growth rate, Complex Systems - Foundations and Applications - Rio de Janeiro, RJ, Brazil (2013).

**Skills**

**Programming**

Proficient in: Python and C.  
Familiar with: Mathematica and R.

**Libraries**

Python: numpy, scipy, pandas, scikit-learn, statsmodels, pymc3, PyStan, networkx, igraph, graph-tool, matplotlib, seaborn.  
C: gsl, igraph.

**Languages**

English (bilingual proficiency), Portuguese (native), Spanish (intermediate)

**Service as editor**

Applied Network Science (Guest Editor)

**Service as reviewer**

Proceedings of the National Academy of Sciences, Physical Review Letters, Physical Review Research, Physical Review E, Nature Communications, Scientific Reports, Journal of Complex Networks, New Journal of Physics, Journal of the Royal Society Interface, PLoS ONE, Proceedings A, EPL (Europhysics Letters), EPJ Data Science, Applied Network Science, Landscape and Urban Planning, Scientometrics, Physics Letters A, Physica A, Journal of Physics, International Journal of Geographical Information Science, Ecological Modeling, Applied Spatial Analysis and Policy, Bulletin of Mathematical Biology, IEEE Transactions on Computational Social Systems, Entropy, Frontiers in Physics.  
Publons profile: <https://publons.com/researcher/1281147/luiz-g-a-alves/>

**Funding reviewer**

FAPESP - São Paulo Research Foundation

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<b>Mentoring</b>	<b>PhD students</b>	
	• Weihua Lei (co-mentor)	2019-Present
	PhD student in Physics, Northwestern University	
	• Hyojun Ada Lee (co-mentor)	2018-2019
	PhD student in Chemical and Biological Engineering, Northwestern University	
	• Gabriel Spadon (co-mentor)	2017-2018
	PhD student in Computer Science, University of São Paulo	
	<b>Master students</b>	
• Pooja Deshpande (co-mentor)	2019-2020	
Master student in Information Systems (Data Science specialization), Northwestern University		
• Bruno Angeli Calza (co-mentor)	2018	
Master's degree in Mathematics, Statistics, and Computing Applied to Industry, University of São Paulo		
	<b>Undergraduate student</b>	
• Samuel Chian (mentor)	2021-Present	
Undergraduate in Applied Mathematics & Statistics, Northwestern University		

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<b>Committees</b>	<b>Thesis committee</b>	
	Candidate: Leonardo Ribeiro Cunha.	March 27, 2020
	Master's thesis: Time series grouping study applied to popularity of online games. State University of Maringá – Department of Physics.	
	<b>Doctoral qualification examining Committee</b>	
	Candidate: Jaqueline Alvarenga Silveira.	September 17, 2018
	Title: Visual analysis of the impact of socioeconomic indicators on crime around schools in São Paulo. University of São Paulo – Graduate program of the Institute of Mathematics and Computer Science.	
	Candidate: Germain Garcia Zanabria.	August 27, 2018
Title: Understanding crime patterns in São Paulo city. University of São Paulo – Graduate program of the Institute of Mathematics and Computer Science.		
<b>Conference organizing committee</b>		
4th Symposium on the Structure and Mobility of Crime, NetSci'19, Burlington, VT, USA. May 27, 2019		
<b>Conference program committee</b>		
Complex Networks 2021, Madrid, Spain.	Nov. 30 - Dec. 2, 2021	
CompleNet live 2021 (online).	May. 24-26 2021	
Complex Networks 2020, Madrid, Spain.	December 1-3, 2020	

CompleNet 2020, Exeter, UK.	Mar. 31-Apr. 3, 2020
Complex Networks 2019, Lisbon, Portugal.	Dec. 10-12, 2019
NetSciX'19, Santiago, Chile.	Jan. 3-5, 2019
NetCrime 2018, NetSci'18 Satellite, Paris, France.	Jun. 12, 2018
Workshop for the ICMC Postdocs, São Carlos, Brazil.	Nov. 8, 2017

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## Teaching experience

### Instructor

Northwestern University Fall/2021  
Northwestern Institute of Complex Systems  
Course: NICO 101/401 - Introduction to Programming for Big Data.

### Invited lecturer

University of São Paulo Jul 1-6, 2019  
Department of Applied Mathematics and Statistics  
School of Applied Mathematics: Machine learning and complex networks applied to crime and corruption.

Getulio Vargas Foundation (FGV) May 23, 2018  
Brazilian School of Public and Business Administration  
Topic: The dynamical structure of political corruption networks .

State University of São Paulo Aug18, 2018  
Department of Mathematics  
Topic: Web scraping, data mining, and machine learning using Python.

### Teaching assistant

University of São Paulo Aug 2017 – Dec 2017  
Department of Applied Mathematics and Statistics  
Course: Scientific Methodology II.

State University of Maringá Mar 2014 – 07/2014  
Department of Civil Engineering  
Course: Electrodynamics (general physics).

State University of Maringá Mar 2014 – Jul/2014  
Department of Chemical Engineering  
Course: Classical mechanics (general physics).

State University of Maringá Jul 2013 – Dec 2013  
Department of Physics  
Course: Methods of Approximation in Physics.

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## Professional memberships

Network science society Apr./2017 – Present

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## Media coverage

- Behind Brazil's True Corruption Mechanism (in Portuguese), [El País](#) (2018).
- The Best of the Physics arXiv, [MIT Technology Review](#) (2018).
- Political corruption scandals may be predicted by network science, [Phys.org](#) (2018).

- Why Nematode Worms Could Hold the Key to Aging, [MIT Technology Review](#) (2017).
- The metrics of urban growth, [Research FAPESP](#) (2015).
- Wood And Charcoal Cut Earthquake Research Down To Size, [Inside Science](#) (2015).
- Murders follow maths law in Brazil, scientists say, [BBC](#) (2013).
- Other media coverage at <https://lgaalves.github.io/post/>