LUYAN YU

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EDUCATION

University of Texas at Austin Aug. 2017 – May 2022 (expected)
Ph.D. Candidate in Physics
Jointly appointed by the Center for Theoretical and Computational Neuroscience
GPA (to date): 3.98/4.00

Nanjing University Sep. 2013 – Jul. 2017
B.S. in Physics
GPA: 4.7/5.0, Ranking: 2/93

WORK EXPERIENCE

Citadel Jun. 2021 – Aug. 2021
Quantitative Research Intern at Global Fixed Income *New York, USA*

- Developed tools for quantitatively analyzing and choosing optimal hedged swaps.
- Performed research and developed trading strategy for bond convexity and built backtesting tools.

RESEARCH EXPERIENCE

For more details, please visit www.yuluyan.com/projects.

Inference of Neuronal Network Properties from Spike Trains Jul. 2020 – Present
Graduate Research with Professor Thibaud Taillefumier *Austin, TX, USA*

- Developed a biological network simulation platform using Mathematica and Python that is extensible and optimized for the specific cases we study.
- Designed algorithms for statistical inference on the experimental neuronal spiking data based on inverse Radon transformation.

Probabilistic Model of Spiking Neural Network (link) Feb. 2019 – July. 2021
Graduate Research with Professor Thibaud Taillefumier *Austin, TX, USA*

- Modelled spiking neural networks with replica mean field approximation and proposed corresponding mean field equations in the form a novel type of delayed differential equations.
- Developed efficient algorithms for calculating statistics of a neural network with arbitrary topologies.
- Predicted the multi-stable states of a type of networks and enabled the calculation of higher moments of those states that are previously untractable.

Tropical Geometry of Phylogenetic Trees (link) Feb. 2019 – Present
Graduate Research with Professor Ngoc Tran Mai *Austin, TX, USA*

- Proved Bernstein's characterization for the extremality of phylogenetic trees as vertices of tropical polytope is sufficient if and only if the tree has 3 leaves. (see publication)

Secure Computation of Deep Neural Networks Jul. 2019 – Jan. 2020
Course Research Project with Professor Risto Miikkulainen *Austin, TX, USA*

- Implemented the secure element-wise integer vector multiplication and polynomial evaluation using the basic operations supported by Zhou-Wornell homomorphic encryption in python with MXNet.
- Propsed and implemented the adaptive evaluation of the non-linear activation layer to reduce accuracy loss ($< 0.3\%$ in MNIST benchmark) introduced by the randomness in encryption.

Learning with Tensor Networks Jan. 2019 – Aug. 2019
Course Research Project with Professor Chandrajit Bajaj *Austin, TX, USA*

- Implemented the classification algorithm using tensor networks (MPS, PEPS) in python.
- Compared the performance with LDA classifier and systematically studied the parametric dependence of the classification performance.

Reinforcement Learning with quantum Boltzmann machine (link) Sep. 2016 – Jul. 2017
Undergraduate Thesis with Professor Shengjun Wu *Nanjing, China*

- Decovered a new phenomenon that quantum restricted Boltzmann machine could overcome local minima occurred during reinforcement learning and used the grid world problem as an benchmark.

Topological Transition in Topological Insulator by Antiferromagnetism Jul. 2016 – Sep. 2016
UCLA-CSST Cross-disciplinary Program with Professor Kang L. Wang *Los Angeles, CA, USA*

- Discovered a non-trivial topological phase transition process in anti-ferromagnetic and topological insulator trilayer structure and numerically recreate the behavior using non-equilibrium Green's function method. (see publication)
- Developed symbolic calculation package in Mathematica of tight binding model and implemented recursive Green's function method for acceleration.

Localization in Quantum Random Walk (link) Jan. 2015 – Nov. 2015
Undergraduate Research with Professor Shengjun Wu *Nanjing, China*

- Proved a key mathematical theorem related to generalized Riemann-Lebesgue lemma for the theoretical existence of the localization phenomenon of quantum walks. (see publication)
- Implemented symbolic simulation package in Mathematica.

PUBLICATIONS

Journals

- **Yu, L.**, & Taillefumier, T. (2021). *Metastable spiking networks in the replica-mean-field limit.* arXiv preprint arXiv:2105.01223.
- **Yu, L.** (2019). *Extreme rays of the ℓ^∞-nearest ultrametric tropical polytope.* Linear Algebra and its Application, 587, 23-44.
- He, Q. L.*, Yin, G.*, **Yu, L.***, Grutter, A. J., Pan, L., Chen, C., Che, X., Yu, G., Zhang, B., Shao, Q., Stern, A. L., Casas, B., Xia, J., Han, X., Kirby, B. J., Lake, R. K., Law, K. T., & Wang, K. L. (2018). *Topological transitions induced by antiferromagnetism in a thin-film topological insulator.* Physics Review Letter, 121(9), 096802. (*These authors contributed equally.)
- Lyu, C., **Yu, L.**, & Wu, S. (2015). *Localization in quantum walks on a honeycomb network.* Physical Review A, 92(5), 052305.

Book Chapters

- Long, H., **Yu, L.**, Sun, R., Wang, S., & Zhou, H. (2018). 2015 Problem 5: Two Balloons. International Young Physicists' Tournament: Problems & Solutions 2015, 31.
- **Yu, L.**, Zhou, Z., Zhu, Z., Gao, W., & Wang, S. (2016). 2014 Problem 12: Cold Balloon. International Young Physicists' Tournament: Problems & Solutions 2014, 113.
- Zhao, W., **Yu, L.**, Chen, L., Wang, S., & Zhou, H. (2016). 2014 Problem 15: Oil Stars. International Young Physicists' Tournament: Problems & Solutions 2014, 133.
- Fan, W., **Yu, L.**, Wang, S., & Gao, W. (2016). 2014 Problem 3: Twisted Rope. International Young Physicists' Tournament: Problems & Solutions 2014, 29.

In Preparation

- Taillefumier, T. & Yu, L. Correlation inference from neural activities

TALKS AND PRESENTATIONS

Metastable spiking networks in the replica-mean-field limit Feb. 2022
Workshop on Mathematical Modeling and Statistical Analysis in Neuroscience *Paris, France*

Delayed differential equation from replica-mean-field limit of exponential model Jan. 2020
17th Annual Theoretical and Computational Neuroscience Conference *Houston, TX, USA*

Extreme rays of the ℓ^∞-nearest ultrametric tropical polytope Nov. 2019
The 2nd Annual Meeting of the SIAM Texas Louisiana Section (invited talk) *Dallas, TX, USA*

HONORS

Scholarships

- Provost's Graduate Excellence Fellowship — 2017–2022, University of Texas at Austin, Texas, USA
- UCLA-CSST Scholarship — 2016, University of California, Los Angeles, USA
- Baosteel Education Scholarship, 5 in Nanjing University — 2016, Bao Steel Education, China
- National Scholarship, for top 0.2% in China — 2014, Ministry of Education, China
- Elite Scholarship, for top 1% in department — 2014–2016, Nanjing University, China

Awards

- Meritorious Winner — 2015, Mathematical Contest in Modeling, USA
- Bronze Medal Winner — 2014, University Physics Competition, USA
- First Award Winner — 2014, Taiwan College Physicists' Tournament, Taiwan, China
- Elite Program Member — 2013, Nanjing University, China

TEACHING EXPERIENCES

- Teaching Asistant of PHY117M Mechanics — Fall 2017 & Spring 2018, Physics Dept.
- Mentor of Numerical ODE — Fall 2018, Directed Reading Program of Math Dept.
- Mentor of Computaional Astronomy — Spring 2020, Directed Reading Program of Physics Dept.
- Tutor of General Physics — Fall 2019 – Spring 2020

TECHNICAL SKILLS

Languages & Tools Python, Mathematica, C++, Javascript, HTML
Tools LaTeX, Microsoft Office, Adobe Illustrator & Photoshop

Last Update: Feb. 15, 2022