Annan Yu

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EDUCATION

Cornell University Ithaca, NY
Doctor of Philosophy – PhD, Applied Mathematics Expected 05/15/2026
GPA – 4.18/4.00

Vanderbilt University Nashville, TN
Bachelor of Science – BS, Computer Science and Mathematics 05/20/2021
Cumulative GPA – 4.00/4.00, *Summa Cum Laude*

SKILLS

Programming Languages Python, Java, C++, JavaScript, MATLAB, HTML
Framework & Tools Git, Linux, PyTorch, JAX, Pandas, Slurm

RESEARCH EXPERIENCE

Amazon Web Services 2795 Augustine Drive, Santa Clara, CA
Applied Scientist 05/27/2025 – 10/04/2025

- Investigated the design choices of time-series foundation models and their implications on chaotic datasets
- Demonstrated the low-rank structure of Transformers for time-series and designed efficient forecasting models
- Authored two preprints submitted to ICLR as first author

Lawrence Berkeley National Laboratory 1 Cyclotron Rd, Berkeley, CA
Student Assistant 05/22/2024 – 08/23/2024
05/22/2023 – 08/14/2023

- Designed mechanisms to improve the efficiency, stability, and robustness to noises of State Space Models (SSM) for time series and sequential data
- Implemented the new SSMs in PyTorch and demonstrated its state-of-the-art performance on tasks that involve long-range dependencies (LRD)
- Authored three peer-reviewed papers published in ICLR (two as spotlight) as first author

Cornell University 377 Pine Tree Rd, Ithaca, NY
Summer Graduate Research Assistant 5/21/2022 – 08/20/2022

- Investigated data-driven reduced order modeling (ROM) techniques of linear time-invariant (LTI) systems
- Designed and implemented a new ROM algorithm that achieves improved numerical stability
- Published a paper in Numerical Linear Algebra with Applications

The Fields Institute for Research in Mathematical Sciences 222 College St, Toronto, Canada
Undergraduate Summer Researcher 07/01/2020 – 08/28/2020

- Invented the notion of H-Chromatic Symmetric Functions that combines H-Coloring of Graphs and Chromatic Symmetric Functions
- Published a paper in the Electronic Journal of Combinatorics

Vanderbilt University 2201 West End Ave, Nashville, TN
Undergraduate Research Assistant 05/15/2020 – 06/30/2020
05/20/2019 – 07/15/2019

- Developed algorithms for triangulating a curved domain and computing with splines
- Published a paper in Computer Aided Geometric Design

PUBLICATIONS

Annan Yu, Danielle C. Maddix, Boran Han, Xiyuan Zhang, Abdul Fatir Ansari, Oleksandr Shchur, Christos Faloutsos, Andrew Gordon Wilson, Michael W. Mahoney, Yuyang Wang. "Understanding Transformers for Time Series: Rank Structure, Flow-of-ranks, and Compressibility." 2025. [under review]

Annan Yu, Danielle C. Maddix, Boran Han, Xiyuan Zhang, Abdul Fatir Ansari, Oleksandr Shchur, Christos Faloutsos, Andrew Gordon Wilson, Michael W. Mahoney, Yuyang Wang. "Understanding the Implicit Biases of Design Choices for Time Series Foundation Models." 2025. [under review]

Annan Yu, N. Benjamin Erichson. "Block-biased Mamba for Long-range Sequence Processing." *Neural Information Processing Systems*, 2025.

Annan Yu, Dongwei Lyu, Soon Hoe Lim, Michael W. Mahoney, N. Benjamin Erichson. "Tuning Frequency Bias of State Space Models." *International Conference on Learning Representations* (spotlight), 2025.

Annan Yu, Michael W. Mahoney, N. Benjamin Erichson. "There is HOPE to avoid HiPPOs for long-memory state space models." *International Conference on Learning Representations* (poster), 2025.

Soon Hoe Lim, Yijin Wang, **Annan Yu**, Emma Hart, S. Xiaoye Li, Michael W. Mahoney, N. Benjamin Erichson. "Elucidating the Design Choice of Probability Paths in Flow Matching for Forecasting." *Transactions on Machine Learning Research*, 2025.

Yihan Wang, Lujun Zhang, Annan Yu, N. Benjamin Erichson, Tiantian Yang. "A Deep State Space Model for Rainfall-runoff Simulations." arXiv:2501.14980, 2024.

Anil Damle, Silke Glas, Alex Townsend, **Annan Yu**. "How to reveal the rank of a matrix?" arXiv:2405.04330., 2024. [under review]

Annan Yu, Arnur Nigmetov, Dmitriy Morozov, Michael W. Mahoney, N. Benjamin Erichson. "Robustifying state-space models for long sequences via approximate diagonalization." *International Conference on Learning Representations* (spotlight), 2024.

Annan Yu, Alex Townsend. "Leveraging the Hankel norm approximation and data-driven algorithms in reduced order modeling." *Numerical Linear Algebra with Applications*; vol 31(4), 2024.

Annan Yu, Alex Townsend. "On the stability of unevenly spaced samples for interpolation and quadrature." *BIT Numerical Mathematics*, vol 63(23), 2023.

Annan Yu, Yunan Yang, Alex Townsend. "Tuning frequency bias in neural network training with nonuniform data." *International Conference on Learning Representations* (poster), 2023.

Nancy Mae Eagles, Angèle M. Foley, Alice Huang, Elene Karangozishvili, **Annan Yu**. "On H-chromatic symmetric functions." *The Electronic Journal of Combinatorics*, vol 29(1), 2022.

Larry Schumaker, **Annan Yu**. "Approximation by polynomial splines on curved triangulations." *Computer Aided Geometric Design*, vol 92, 2022.

Annan Yu, Chloe Becquey, Diana Halikias, Matthew E. Mallory, Alex Townsend. "Arbitrary-depth universal approximation theorems for operator neural networks." arXiv:2109.11354., 2021. [preprint]

TALKS

Yu, Annan. "Remember me: a fine-grained analysis of input-selective Mamba models for temporal data." SIAM Conference on Applications of Dynamical Systems (DS25), Denver, USA, 2025.

Yu, Annan. "How to train a rational function?" BIRS Workshop: Challenges, Opportunities, and New Horizons in Rational Approximation, Banff, Canada, 2025.

Yu, Annan. "State space models for forecasting time series." SIAM Conference on Computational Science and Engineering (CSE25), Fort Worth, USA, 2025.

Yu, Annan. "Deep learning with state space models." SIAM Student Chapter Seminar, Virginia Tech, USA, 2025. (online)

Yu, Annan. "Training an LTI system without an objective: a numerical analyst's perspectives on state-space models." Lunch Talk invited by Dr. Mert Pilanci, Stanford University, Stanford, USA, 2025.

Yu, Annan. "Training an LTI system without an objective: a numerical analyst's perspectives on state-space models." Mid-Atlantic Numerical Analysis Day, Temple University, Philadelphia, USA, 2024.

Yu, Annan. "How does a machine learn sequences: an applied mathematician's guide to transformers, state-space models, mamba, and beyond." SIAM Conference on Mathematics of Data Science (MDS24), Atlanta, USA, 2024. (2-hour tutorial)

Yu, Annan. "Representations and evolution of linear time-invariant systems in state-space models." International Symposium on Mathematical Theory of Networks and Systems, University of Cambridge, UK, 2024.

Yu, Annan. "Rectifying unstable rational representations in sequence models." SIAM Conference on Applied Linear Algebra, Sorbonne Université, Paris, France, 2024.

Yu, Annan. "Robustifying state-space models for long sequences via approximate diagonalization." ICLR, Vienna, Austria, 2024.

Yu, Annan. "How to avoid HiPPOs?" SCAN Seminar, Cornell University, USA, 2024

Yu, Annan. "Robustifying state-space models via approximate diagonalization." SciDAC AI monthly synchronization, Lawrence Berkeley National Laboratory, USA, 2024. (online)

Yu, Annan. "Linear time-invariant systems in machine learning." SIAM New York-New Jersey-Pennsylvania (NNP) Section Annual Meeting, New Jersey Institute of Technology, USA, 2023. (50-minute tutorial)

Yu, Annan. "Leveraging the Hankel norm approximation and data-driven algorithms in reduced order modeling." Numerical Analysis in the 21st Century, University of Oxford, UK, 2023.

Yu, Annan. “Leveraging the Hankel norm approximation and block-AAA algorithms in reduced order modeling.” SIAM Southeastern Atlantic (SEAS) Section Annual Meeting, Virginia Tech, USA, 2023.

Yu, Annan. “Tuning frequency bias in neural network training.” ICLR, 2023. (online)

Yu, Annan. “Tuning frequency bias in neural network training.” Workshop on Numerics and Acoustics, Imperial College London, UK, 2022.

Yu, Annan. “H-chromatic symmetric functions.” 2020 FUSRP Mini-Conference, The Fields Institute for Research in Mathematical Sciences, Canada, 2020. (online)

TEACHING EXPERIENCE

Cornell University 377 Pine Tree Rd, Ithaca, NY
Recitation Teaching Assistant 08/15/2022 – 12/20/2022
08/15/2023 – 12/20/2023

- Lectured recitation sessions of MATH 6110 Real Analysis, and MATH 2310 Linear Algebra with Applications

Vanderbilt University 2201 West End Ave, Nashville, TN
Teaching Assistant/Grader 01/15/2018 – 12/20/2018
08/20/2019 – 12/20/2020

- Teaching Assistant (TA) for CS 3251 Intermediate Software Design and CS 1101 Programming and Problem Solving
- Grader for MATH 3620 Introduction to Numerical Mathematics, MATH 3100 Introduction to Analysis, MATH 3620 Introduction to Numerical Mathematics, MATH 3200 Introduction to Topology, and MATH 2300 Multivariable Calculus
- Held weekly office hours and graded assignments, projects, and exams

HONORS & AWARDS

RICHARD J. LARSEN AWARD FOR ACHIEVEMENT IN UNDERGRADUATE MATHEMATICS

- Conferred by the Department of Mathematics at Vanderbilt University in April 2021.
- The award, along with a check for $500, is presented each spring to the senior math major judged by the faculty to have excelled in all aspects of undergraduate mathematics.

WILSON L. AND NELLIE PYLE MISER AWARD

- Conferred by the School of Engineering at Vanderbilt University in April 2021.
- This award is given to the senior who has excelled in all aspects of mathematics during the student’s undergraduate career.