Annan Yu

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EDUCATION

CORNELL UNIVERSITY
Ithaca, NY
Ph.D. Applied Mathematics (Expected Graduation May 2026)
- **Advisor:** Prof. Alex Townsend
- **GPA:** 4.18/4.00

VANDERBILT UNIVERSITY
Nashville, TN
B.S. Computer Science and Mathematics, 2021
Summa Cum Laude
Highest Honors in Mathematics, Honors in Computer Science
- **GPA:** 4.00/4.00
- **Senior Thesis Title:** *Geometric Analysis of Quasilinear Wave Equations*

RESEARCH INTERESTS

Deep Learning, Sequence Modeling, Numerical Analysis, Reduced-order Modeling

PROGRAMMING LANGUAGES

Python (including PyTorch), MATLAB, C++, JavaScript, Java

PUBLICATIONS AND PREPRINTS

[1] Annan Yu, Michael W. Mahoney, N. Benjamin Erichson, *There is HOPE to avoid HiPPOs for long-memory state space models*, arXiv:2405.13975.

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

[3] 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.

[4] Annan Yu, Alex Townsend, *Leveraging the Hankel norm approximation and block-AAA algorithms in reduced order modeling*, Numerical Linear Algebra with Applications; e2555, 2024.

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

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

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

[8] 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.

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

INVITED TALKS

Representations and evolution of linear time-invariant systems in state-space models, 26th International Symposium on Mathematical Theory of Networks and Systems, University of Cambridge, UK, 2024.

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

Robustifying state-space models for long sequences via approximate diagonalization, International Conference on Learning Representations, Vienna, Austria, 2024.

How to avoid HiPPOs?, SCAN Seminar, Cornell University, USA, 2024

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

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

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

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

Tuning frequency bias in neural network training, International Conference on Learning Representations, 2023. (online)

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

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

RESEARCH EXPERIENCE

LAWRENCE BERKELEY NATIONAL LABORATORY, Berkeley, CA, USA
Summer Research Internship, May 2023 - August 2023
- Supervised by Professor Michael Mahoney, Dr. Dmitriy Morozov, and Dr. Benjamin Erichson.
- Analyzed different initialization schemes of state-space models and improved them.
- Published the paper *Robustifying state-space models for long sequences via approximate diagonalization*.

THE FIELDS INSTITUTE FOR RESEARCH IN MATHEMATICAL SCIENCES, Toronto, ON, Canada
Summer Research Internship, July 2020 - August 2020
- Supervised by Professor Angèle Foley.
- Defined the new concept of H-chromatic symmetric function, conducted numerical experiments, and formulated and proved its properties.
- Published the paper *On H-chromatic symmetric functions*.

MATH DEPARTMENT AT VANDERBILT UNIVERSITY, Nashville, TN, USA
Summer Research Internship, May 2019 - Jul 2019, May 2020 - Present
- Assistant to Professor Larry Schumaker.
- Implemented over 10000 lines of MATLAB code.
- Designed and analyzed algorithms in a forthcoming book on spline functions.
- Published the paper *Polynomial Splines on Curved Triangulations*.

TEACHING EXPERIENCE

MATH DEPARTMENT AT CORNELL UNIVERSITY, Ithaca, NY
Recitation Teaching Assistant, August 2022 - Present
- Fall 2023: MATH 6110, Real Analysis (1 recitation section)
- Fall 2022: MATH 2310, Linear Algebra with Applications (2 recitation sections)

MATH DEPARTMENT AT VANDERBILT UNIVERSITY, Nashville, TN

Grader/Teaching Assistant, Jan 2018 - Dec 2020

- Fall 2020: MATH 3620, Introduction to Numerical Mathematics
- Spring 2020: MATH 3100, Introduction to Analysis
- Spring 2020: MATH 3620, Introduction to Numerical Mathematics
- Fall 2019: MATH 3200, Introduction to Topology
- Spring 2018: MATH 2300, Multivariable Calculus

EECS DEPARTMENT AT VANDERBILT UNIVERSITY, Nashville, TN

Grader/Teaching Assistant, Aug 2018 - Dec 2019

- Fall 2019: CS 3251, Intermediate Software Design
- Fall 2018: CS 1101, Programming and Problem Solving

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.

RELEVANT COURSEWORK

MATHEMATICS

Spring 2023

MATH 6230, Differential Games and Optimal Control

Spring 2022

MATH 6150, Partial Differential Equations

Fall 2021

MATH 5250, Numerical Analysis and Differential Equations
MATH 6710, Probability Theory I

Spring 2021

MATH 4201, Topology II

MATH 7130, Harmonic Analysis

Fall 2020

MATH 4200, Topology I

MATH 7100, Complex Analysis

Spring 2020

MATH 3110, Complex Variables

MATH 3230, Introduction to Differential Geometry

MATH 6101, Real Analysis II

Fall 2019

MATH 3300, Abstract Algebra

MATH 3890, Selected Topics: Computing with Splines

MATH 6100, Real Analysis I

Spring 2019

MATH 3100, Introduction to Analysis

MATH 3200, Introduction to Topology

MATH 4630, Nonlinear Optimization

MATH 4700, Combinatorics

Fall 2018

MATH 3620, Introduction to Numerical Math

MATH 3640, Probability

MATH 3700, Discrete Mathematics

MATH 4710, Graph Theory

Spring 2018

MATH 2600, Linear Algebra

Fall 2017

MATH 2300, Multivariable Calculus

MATH 2400, ODE with Linear Algebra

COMPUTER SCIENCE

Fall 2023
CS 6241, Numerical Methods for Data Science

Fall 2022
CS 6783, Machine Learning Theory

Spring 2022
CS 6210, Matrix Computations

Fall 2021
CS 6820, Analysis of Algorithms

Spring 2021
CS 1151, Computers and Ethics
CS 4269, Project in Artificial Intelligence
Fall 2020
CS 3281, Operating Systems I
CS 4260, Artificial Intelligence

Spring 2020
CS 3270, Programming Languages
CS 6310, Graduate-level Algorithms

Fall 2019
CS 3250, Algorithms
CS 4262, Foundations of Machine Learning

Spring 2019
CS 2231, Computer Organization
CS 3251, Intermediate Software Design

Fall 2018
EECE 2116, Digital Logic

Summer 2018 (at Stanford University)
CS 106B, Data Structures
CS 193C, Client-side Web Technologies
STAT 202, Data Mining

Spring 2018
CS 1101, Programming and Problem Solving
CS 2212, Discrete Structure