

# Huy Tuan Pham

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## RESEARCH INTERESTS

Extremal and probabilistic combinatorics, additive combinatorics, probability theory and applications, statistical learning, theoretical computer science

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## EDUCATION

**Stanford University**, Stanford, CA, USA 2019-2024 (expected)  
PhD in Mathematics  
**University of Cambridge**, Cambridge, UK 2018-2019  
MASt in Mathematics with Distinction. **Rank 1 of Part III**  
**Stanford University**, Stanford, CA, USA 2014-2018  
MS in Statistics  
BS in Mathematics (Honors) with a Minor in Computer Science. GPA: **4.14/4.3**

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## SELECTED AWARDS AND DISTINCTIONS

**Pure Mathematics Prize** - University of Cambridge 2019  
– Awarded to best student in Pure Mathematics at Part III of the Mathematical Tripos.  
**Leslie Walshaw Prize, Examination Prize, Senior Scholarship** - Trinity College, University of Cambridge 2019  
– Awarded for exam performance at Part III of the Mathematical Tripos.  
**Honorable Mention - Morgan Prize** 2018  
– Awarded for outstanding research in mathematics.  
**Kennedy Thesis Prize in the Natural Sciences** - Stanford University 2018  
– Awarded to the best senior honors thesis in each of the following areas of study: humanities, social sciences, natural sciences, and engineering and applied sciences.  
**The Firestone Medal for Excellence in Undergraduate Research** - Stanford University 2018  
– Awarded to the top ten percent of all honors theses in the social sciences, natural sciences, and engineering and applied sciences.  
**J. E Wallace Sterling Award for Scholastic Achievement** - Stanford University 2018  
– Awarded to the top 25 graduating students of the School of Humanities and Sciences.  
**Deans' Award for Academic Achievement** - Stanford University 2017  
– Awarded to between five and ten extraordinary undergraduate students, based on excellent academic achievements and independent research.  
**Honourable Mention (Top 80)** - Putnam Competition 2017, 2016, 2015, 2014  
**Gold Medal** - International Mathematical Olympiad (IMO) 2014, 2013  
**Highest Score** - Vietnam Mathematical Olympiad & Team Selection Test 2014, 2013

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## SELECTED PUBLICATIONS

– P.-M. Nguyen and H. T. Pham, A Rigorous Framework for the Mean Field Limit of Multilayer Neural Networks, to be submitted. [[arXiv](#)]  
– D. Conlon, J. Fox and H. T. Pham, Subset sums, completeness and colorings, in preparation.  
– H. T. Pham and M. W. Xu, Irreducibility of random polynomials of bounded degree, submitted. [[arXiv](#)]  
– J. Fox, H. T. Pham, Y. Zhao, Tower-type bounds for Roth's theorem with popular differences, in preparation.  
– J. Fox and H. T. Pham, Popular monochromatic progression differences, in preparation.  
– J. Fox, H. T. Pham, Y. Zhao, Common and Sidorenko linear equations, submitted. [[arXiv](#)]  
– J. Fox and H. T. Pham, Popular progression differences in vector spaces, International Mathematics Research Notices, to appear. [[link](#)]  
– J. Fox and H. T. Pham, Popular progression differences in vector spaces II, Discrete Analysis, 2019:16. [[link](#)]

PRESENTATIONS	<p>Vietnam Workshop on Graph Theory and Discrete Geometry, Vietnam Institute for Advanced Study in Mathematics Sep 2016</p> <p>Pseudorandomness, Simons Institute for the Theory of Computing April 2017</p> <p>Combinatorics Seminar, Stanford University Oct 2017</p> <ul style="list-style-type: none"> <li>– Present works on popular progression differences in groups.</li> </ul> <p>Part III Seminar, University of Cambridge 2019</p> <ul style="list-style-type: none"> <li>– Present work on the structure of subset sums.</li> </ul> <p>Combinatorics Reading Seminar, Stanford University 2018, 2019, 2020</p> <ul style="list-style-type: none"> <li>– Present on hypergraph containers method, almost periodicity and geometric graph theory.</li> </ul>
SELECTED RESEARCH PROJECTS	<hr/> <p>Research Project (ongoing): Large deviations for subgraph counts in sparse Erdős-Rényi random graphs and hypergraphs. Advisor: Amir Dembo Sep 2019 - present</p> <p>Research Project (ongoing): Large homogeneous subsets in partial orders and applications in geometric graph theory. Advisor: Jacob Fox Jan 2020 - present</p> <p>Research Project (ongoing): The structure of subset sums and related conjectures. Jan 2019 - present</p> <ul style="list-style-type: none"> <li>– Resolve several long-standing conjectures of S. Burr and P. Erdős and of N. Alon and P. Erdős on subset sums. Joint work with David Conlon and Jacob Fox.</li> </ul> <p>Research Project (ongoing): The mean field limit of multilayer neural networks and global convergence guarantees of stochastic gradient descent. Jan 2019 - present</p> <ul style="list-style-type: none"> <li>– Construct a rigorous framework for the mean field limit of stochastic gradient descent dynamics of multilayer neural networks, prove global convergence guarantees for certain network models. Joint work with Phan-Minh Nguyen.</li> </ul> <p>Course Project: Competitive ratio of the batching algorithm for matching with deadline. Instructor: Amin Saberi Sep 2019 - Dec 2019</p> <p>Part III Essay: Almost Periodicity and applications. Advisor: Julia Wolf Jan 2019 - June 2019</p> <p>Course Project: Stochastic Processes on Graphs. Instructors: Amir Dembo, Andrea Montanari Sep 2017 - Dec 2017</p> <ul style="list-style-type: none"> <li>– Prove the existence of the free energy limit of the ferromagnetic Ising model on random regular hypergraphs. Result unpublished.</li> </ul> <p>Research Project: Popular arithmetic progression differences. Advisor: Jacob Fox. Sep 2016 - Jun 2018</p> <ul style="list-style-type: none"> <li>– Prove tight tower-type bounds for the existence of popular arithmetic progression differences in vector spaces and general abelian groups. Joint works with Jacob Fox and Yufei Zhao.</li> </ul>
WORKSHOPS AND RESEARCH PROGRAMS	<hr/> <p>Workshop on Additive Combinatorics, Center of Mathematical Sciences and Applications, Harvard University Oct 2017</p> <p>Pseudorandomness, Simons Institute for the Theory of Computing Jan 2017 - May 2017</p> <p>Workshop on Probabilistic and Extremal Combinatorics, Center of Mathematical Sciences and Applications, Harvard University Feb 2017</p>
TECHNICAL BACKGROUND & COURSEWORK	<hr/> <ul style="list-style-type: none"> <li>– Probability: Probability theory. Stochastic calculus. Schramm-Loewner evolution. Random matrix theory. Stochastic processes on graphs. Concentration inequalities. Percolation and random walk on graphs.</li> <li>– Combinatorics: Additive combinatorics. Extremal combinatorics. The probabilistic method. Non-constructive methods in combinatorics. The polynomial method in combinatorics. Algebraic combinatorics and symmetric polynomials. Polyhedral techniques in combinatorics. Approximate groups. Geometric graph theory.</li> <li>– Machine learning. Deep learning. Optimal transport. Convex optimization. Sum-of-squares hierarchy. Advanced algorithms. Pseudo-randomness. Information theory. Game theory. Matching theory.</li> <li>– Graduate real analysis. Graduate algebra. Riemannian geometry. Algebraic topology. Analysis of PDEs. Analytic number theory. Ergodic theory. Geometric group theory.</li> </ul>
OTHERS	<hr/> <ul style="list-style-type: none"> <li>– Programming skills: Working proficiency in Matlab, Python. Experience in R, C, C++, Java.</li> </ul>