

NINTH ANNUAL PRIMES CONFERENCE 2019

Program for Research In Mathematics, Engineering, and Science for High School Students



Photo: AboveSummit and Christopher Harting

Saturday, May 18

8:45 am Welcoming remarks

Prof. Michel Goemans, Head of the MIT Mathematics Department
Prof. Pavel Etingof, PRIMES Chief Research Advisor
Dr. Slava Gerovitch, PRIMES Program Director

9:15 am Session 1: Fractals and Visualization Algorithms

Jason Liu, *Approximating the dimension of circle packings* (mentor Prof. Sergiy Merenkov, CCNY – CUNY)
Oliver Hayman, *Analyzing visualization and dimensionality-reduction algorithms* (mentor Ashwin Narayan)
Ziyan (Heidi) Lei, *Fractals: Hausdorff dimension, the Koch curve, and visibility* (mentor Dr. Tanya Khovanova)

10:15 am Session 2: Applied Mathematics

Tejas Gopalakrishna, *Analysis of the one line factoring algorithm on large semiprimes* (mentor Yichi Zhang)
Yizhen Chen, *Mobile sensor networks: Bounds on capacity and complexity of realizability* (mentor Dr. Jesse Geneson, Iowa State)
Sanjit Bhat, *Probing the structure of deep neural networks with universal adversarial perturbations* (mentor Dimitris Tsipras)

11:15 am Session 3: Geometry and Topology

Zander Hill, *On the distortion of torus knots* (mentor Luis Kumanduri)
Nithin Kavi, *Cutting and gluing surfaces* (mentor Zhenkun Li)
Srinivasan Sathiamurthy, *Critical lattices of symmetric convex domains* (mentor Anurag Rao, Brandeis University)

12:00 pm Lunch in honor of PRIMES head mentor Dr. Tanya Khovanova's 60th birthday



1:30 pm Session 4: Combinatorics

Sebastian Jeon, *3-symmetric graphs* (mentor Dr. Tanya Khovanova)
Lucy Cai, Espen Slettnes, and Jeremy Zhou, *Extracting tree-statistics from the quasisymmetric Bernardi polynomial* (mentor Duncan Levear, Brandeis University)

2:35 pm Session 5: Algebra

Rupert Li, *Compatible recurrent identities of the sandpile group and maximal stable configurations* (mentor Yibo Gao)
Victor Luo and Sasha Shashkov (reading group), *Introduction to representation theory* (mentor Yau Wing Li)
Elias Sink and Allen Wang (reading group), *Character theory of finite groups* (mentor Christopher Ryba)

3:40 pm Session 6: Algebraic Geometry and Representation Theory

Lev Kruglyak, *The rational Cherednik algebra of type A_1 with divided powers in characteristic p* (mentor Daniil Kalinov)
Frank Wang, *The shuffle algebra of the Hilbert scheme of the plane* (mentor Yu Zhao)
Arav Karighattam, *The Galois group of the 27 lines on a rational cubic surface* (mentor Yongyi Chen)
Brandon Wang, *Quotients of tropical moduli spaces* (mentor Dr. Dhruv Ranganathan, University of Cambridge)

4:50 pm Session 7: PRIMES Circle

Peter Haine, PRIMES Circle Coordinator, *Introduction*
Tal Berdichevsky and Corinne Mulvey, *Graph theory and map coloring* (mentor Agustin Garcia)
Ishita Goluguri and Christina Li, *Burnside's lemma: A combinatorial application of group actions* (mentor Maya Sankar)
Hanfei Cui and Trisha Lahiry, *Multiplicity, convolution, and the Möbius inversion formula* (mentor Michael Tang)

Sunday, May 19

Room 4-370, MIT
web.mit.edu/primes

8:45 am Welcoming remarks

Dr. Slava Gerovitch, PRIMES Program Director
Dr. Tanya Khovanova, PRIMES Head Mentor

9:00 am Session 8: Combinatorics

Ezra Erives, *Mixed strategy equilibria for winner takes all variant of Colonel Blotto* (mentor Dr. Zarathustra Brady)
Kevin Wu, *On base $3/2$ and greedy partitioning of integers* (mentor Dr. Tanya Khovanova)
Isha Agarwal, Paul Braverman, Patrick Chen, William Du, Kaylee Ji, Akhil Kammila, Shane Lee, Alicia Li, Anish Mudide, Jeffrey Shi, Maya Smith, and Isabel Tu (PRIMES STEP Junior group), *Weighing coins, losing weight, and saving money* (mentor Dr. Tanya Khovanova)
Matvey Borodin, Aidan Duncan, Joshua Guo, Kunal Kapoor, Anuj Sakarda, Jerry Tan, Armaan Tipirneni, Max Xu, and Kevin Zhao (PRIMES STEP Senior group), *Common knowledge: Games of logic* (mentor Dr. Tanya Khovanova)

10:20 am Session 9: Combinatorics

Benjamin Wright, *Maximal extensions of differential posets* (mentor Christian Gaetz)
Christopher Zhu, *Enumerating permutations with singleton double descent sets* (mentor Pakawut Jiradilok)
Justin Yu, *On subset sums and thin additive bases* (mentor Dr. Asaf Ferber)
Andrew Weinfeld, *Bases for quotients of symmetric polynomials* (mentor Guangyi Yue)

11:30 am Session 10: Applied Mathematics

Janabel Xia, *Sampling over tilings of the plane: A Computational approach against political gerrymandering* (mentor Younhun Kim)
Benjamin Kang, *All-pay auctions with different forfeit functions* (mentor Prof. James Unwin, University of Illinois at Chicago)
Yuyuan Luo, *Minimal percolating sets with time-dependent bootstrap percolation* (mentor Prof. Laura Schaposnik, University of Illinois at Chicago)
Victoria Zhang, *Patterns and symmetries in networks of spiking neurons* (mentor Dr. Bolun Chen, Brandeis University)
Sunay Joshi, *On the degenerate Turán problem and its variants* (mentor Dr. Zilin Jiang)

1:30 pm Session 11: PRIMES Circle

Peter Haine, PRIMES Circle Coordinator, *Introduction*
Sofia Mrowka, Elizabeth Zhong, and Natasa Zupanski, *Game theory: A playful presentation* (mentor Marisa Gaetz)
Michelle Li and Ella Serrano-Wu, *Solving problems in combinatorics using induction and generating functions* (mentor Uma Roy)
Ai-Wen Joy Lim and Eve Martin, *The application of knot theory to models in statistical mechanics* (mentor Radha Mastandrea)
Ildi Hoxhallari and Brian Kubinec, *Probability, discrete distributions and Markov chains* (mentor Daniel León Jiménez)

3:00 pm Session 12: Computer Science

Prof. Srinu Devadas, Department of Electrical Engineering and Computer Science, *Welcoming Remarks*
David Lu, *Group messaging in the XRD private communication system* (mentor Albert Kwon)
Shashvat Srivastava, *AnonStake: An anonymous proof-of-stake cryptocurrency via zero-knowledge proofs and Algorand* (mentor Kyle Hogan)
Robert Chen, *Scalable distributed key generation* (mentor Alin Tomescu)
Yiming Zheng, *Vector commitments from univariate polynomials and their applications* (mentor Alin Tomescu)
John Kuszmaul, *Verkle trees: Ver(y short Mer)kle trees* (mentor Alin Tomescu)

