Shihan Kanungo

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725 Chimalus Dr. Palo Alto, CA 94306
US citizen

Education

2023–2026 **San José State University**, San José, CA, GPA: 4.0.
Concurrently enrolled as a high school student. Taken 11 mathematics courses so far.

2022–2026 **Henry M. Gunn High School**, Palo Alto, CA., GPA: 3.96UW, 4.46W.

Contests & Test Scores

Aug 2022 **SAT**, 1550 (790 M, 760 EBRW) (99^{th} percentile).
Took the SAT when I was 12 years old.

Jun 2024 **USAPhO (USA Physics Olympiad)**, US Physics Team (Top 20 in USA).
The United States Physics Olympiad (USAPhO) is a high school physics competition run by the American Association of Physics Teachers and the American Institute of Physics to select the team to represent the United States at the International Physics Olympiad (IPhO). The team is selected through a series of exams testing their problem solving abilities. The top 20 finalists are invited to a rigorous study camp at the University of Maryland to prepare for the IPhO.

Feb 2023 **USAMTS (USA Mathematical Talent Search)**, *74/75*, Gold medal.
The United States of America Mathematical Talent Search (USAMTS) is a proof and research based mathematics competition open to all United States students in or below high school.

Apr 2022 **USAMO (USA Mathematical Olympiad)**, *8/42*, (65^{th} percentile).
The United States of America Mathematical Olympiad (USAMO) is a highly selective high school mathematics competition. Since its debut in 1972, it has served as the final round of the American Mathematics Competitions. Top scorers are invited to join the Mathematical Olympiad Program to compete and train to represent the United States at the International Mathematical Olympiad.

Feb 2022 **Math Kangaroo, Level 12**, 4th in USA, (at age 12).
Math Kangaroo is an international math competition for students in grades 1–12 that evaluates their problem-solving and logical thinking skills

Feb 2022, '24 **AIME**, *11/15*, (97^{th} percentile).
The American Invitational Mathematics Examination (AIME) is a selective and prestigious test given to top scorers on the AMC tests. The AIME is the second of two tests used to determine qualification for the United States Mathematical Olympiad (USAMO), the first being the AMC.

Nov 2022, 23 **AMC 12**, Honor Roll of Distinction (99^{th} percentile).
The American Mathematics Competitions (AMCs) are the first of a series of competitions in secondary school mathematics sponsored by the Mathematical Association of America that determine the United States of America's team for the International Mathematical Olympiad (IMO).

Assessments

2018 **Weschsler Intelligence Scale For Children: 5th Ed (WISC-V)**.
General Abilities Index (GAI) 154; Full Scale IQ (FSIQ) 150
Both scores >99.9th percentile. Evaluated as "profoundly gifted".

2018 **Johns Hopkins University's Center for Talented Youth (CTY)**.
- SCAT: High Honors award; Advanced-CTY Level
  Scores reflect ability four grade levels above current grade.
- SET (Study of Exceptional Talent): Qualified by scoring 1550 on SAT before turning 13.

Fellowships & Awards

2024 **World Science Scholar (WSS)**.
Selects a small group of high school students with extraordinary mathematical talent to solve problems in a range of scientific fields in projects led by world-renowned scientists.

2023 **Spirit of Ramanujan Fellow**.
The Spirit of Ramanujan STEM Talent Initiative grants about 35 winners, globally, each year, up to $5,000 USD each to fund participation in research.

2018 **Davidson Young Scholars (DYS) program**.
Program designed to support the educational and developmental needs of profoundly intelligent young people between the ages of 5 and 18 in the United States.

Research Experience

2024 **MIT PRIMES–USA**, (with Sidarth Erat, Arun Kannan).
Mixed Tensor Products, Capelli Berezinians, and Newton's Formula for $\mathfrak{gl}(m|n)$.
arXiv:2409.02422 Reference: Arun Kannan (MIT)

2024 **San Josè State University (SJSU)**, (with Jordan Schettler).
On Product Formulas of Guillera and Sondow. Reference: Jordan Schettler (SJSU)

2023 **MIT PRIMES–USA**, (with Henry Jiang, Harry Kim).
A weaker notion of the finite factorization property. Commun. Korean Math. Soc. **39** (2024), No. 2, 313-329. arXiv:2307.09645 Reference: Felix Gotti (MIT)

Publications and preprints

2024 **Mixed Tensor Products, Capelli Berezinians, and Newton's Formula for** $\mathfrak{gl}(m|n)$, *S. Erat, A. Kannan,* ***S. Kanungo****.* arXiv:2409.02422.

2024 **A weaker notion of the finite factorization property**, *H. Jiang,* ***S. Kanungo****, H. Kim.* Commun. Korean Math. Soc. **39** (2024), no. 2, 313-329. arXiv:2307.09645

Expository Papers

Jun 2024 **Large Gaps Between Primes**, *Analytic Number Theory*.

Mar 2024 **Dynamical Billiards**, *Ergodic Theory*.

Dec 2023 **Arithmetic Dynamics**, *Number Theory*.

Jun 2022 **Minimal surfaces**, *Differential Geometry*.

Dec 2021 **Herbert Wilf's snake-oil method**, *Generating Functions*.

Dec 2020 **Mixing-time estimates for the riffle shuffle**, *Markov Chains*.

Mar 2020 **Classifying groups of certain orders**, *Abstract Algebra*.

Camps & Programs

Jun 2024 **U.S. Physics Team Training Camp**, *University of Maryland*.
The team is selected through a series of exams. The top 20 finalists are invited to a rigorous study camp at the University of Maryland to prepare for the IPhO.

Aug 2024 **MAA MathFest 2024, Research in Motion**, *Presenter*.

Jan 2024 **JMM 2024, AMS-PME Student Poster Session**, *Presenter*.
H. Jiang, **S. Kanungo**, H. Kim, *A weaker notion of the finite factorization property*.

Summer 2023 **Special Lectures, Kharkiv-Vienna International Science School**, *Invitee*.
Lectures by Martin Hairer, Günter M Ziegler, etal. Participation is by invitation only.
Reference: Michael Eichmair. 2 weeks

Summer 2023 **The Summer Workshop for Intrepid Mathematicians (SWIM 2023)**, *Presenter*.
Henry Jiang, **Shihan Kanungo**, Harry Kim, *The length-finite factorization property*.
Reference: Felix Gotti, MIT. 4 weeks

Computer/Coding

Python **Fluent coder**, *Intermediate Programming with Python*, AoPS, Grade: A+.

Java **Fluent coder**, *Functional & Object-oriented Programming* (*H*), Grade: A.

LaTeX **Proficient**, Written multiple scientific papers.

Spreadsheet **Good at analyzing data**.

Music

Summer 2024 **Duke Ellington award**, *Stanford Jazz Workshop*.
Outstanding Musicianship award, *Stanford Jazz Workshop*.

Spring 2024 **Composed music for**, *Midsummer Night's Dream*, Gunn Theatre Spring Show.

Fall 2023 **First place**, *Northern California Young Talents Competition*, solo violin.

2022 – 2023 **Assistant concertmaster**, *Camilla Kolchinsky Orchestra*, GSYO.

2020 – 2022 **Concertmaster**, *Camerata Orchestra; Chamber Players Orchestra*, GSYO.

2014 – 2020 **Piano**, studied classical piano for 6 years.

Languages

English **Mothertongue**

French **Intermediate** *Conversationally fluent*

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Transcript of Mathematics & Programming Coursework

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Henry M. Gunn High School

2023 – 2024 **AP Statistics**, Grade: A, AP 5/5.
Data analysis, experimental and survey design, random variables, and inferential statistics.

2022 – 2023 **AP Calculus BC**, Grade: A, AP 5/5.
Differentiation, integration, Taylor series, simple differential equations, vectors & applications.

2022 – 2023 **FOOP (H), Functional Object Oriented Programming**, Grade: A.
Data abstraction, recursion, arrays, interfaces, inheritance, and polymorphism.

San José State University (SJSU)

Fall 2024 **MATH 279A**, *Graph Theory*, (Graduate level).
Connectedness, Eulerian circuits, Hamiltonian cycles, graph colorings and Ramsey theory.

Fall 2024 **MATH 229**, *Advanced Matrix Theory*, (Graduate level).
Schur's theorem. Normal, Hermitian, positive-definite matrices, SVD and polar form.

Spring 2024 **MATH 234**, *Advanced Dynamical Systems*, (Graduate level), Grade: A+.
Continuous and discrete systems; stability of equilibria and closed orbits, structural stability.

Spring 2024 **MATH 226**, *Theory of Numbers*, (Graduate level), Grade: A+.
Primes in arithmetic progressions, partitions, modular group, and the Dedekind eta function.

Fall 2024 **MATH 231A**, *Real Analysis*, (Graduate level).
σ–algebras, differentiation, product measures, integration theory, the spaces L^1 and $\mathbb{C}$.

Fall 2023 **MATH 138**, *Complex Variables*, Grade: A+.
Analytic functions, complex integration, residues and power series, conformal mapping.

Fall 2024 **MATH 131B**, *Introduction to Real Variables*.
The theory of the Riemann integral, sequences and series of functions, spaces of functions.

Spring 2024 **MATH 131A**, *Introduction to Analysis*, Grade: A+.
Completeness and compactness of $\mathbb{R}$. Continuity, uniform continuity, the derivative.

Fall 2024 **MATH 179**, *Introduction to Graph Theory*.
Hamiltonian and Eulerian graphs, matching, connectivity, coloring problems and planarity.

Spring 2024 **MATH 129B**, *Linear Algebra II*, Grade: A+.
Cayley-Hamilton theorem, minimal polynomials, Jordan canonical form, inner products.

Fall 2023 **MATH 129A/39**, *Linear Algebra I*, Grade: A.
Matrices, systems of linear equations, eigenvectors and eigenvalues, inner product spaces.

Euler Circle

Fall 2024 **Combinatorial Game Theory**, *Advanced Class*.
Nim, Hackenbush, surreal numbers, impartial games, Sprague-Grundy theory.

Spring 2024 **Analytic Number Theory**, *Advanced Class*.
Dirichlet's Theorem, The Prime Number Theorem, Brun's theorem, smooth numbers.

Winter 2024 **Ergodic Theory**, *Advanced Class*.
Poincarè recurrence theorem, invariant measures, multiple recurrence, Szemeredi's theorem.

Fall 2023 **Number Theory**, *Advanced Class*.
Reciprocity theorems, quadratic forms, elliptic curves, modular curves.

Spring 2022 **Differential Geometry**, *Advanced Class*.
Curves, surfaces, curvature, Gauss' Theorema Egregium, Gauss-Bonnet Theorem.

Fall 2021 **Generating Functions**, *Advanced Class*.
Ordinary, exponential & multivariate GFs, growth rate and asymptotic analysis.

Fall 2020 **Markov Chains**, *Advanced Class*.
Absorbing and ergodic Markov chains, mixing and stopping times, spectral analysis.

Spring 2020 **Abstract Algebra**, *Advanced Class*.
Group theory, Sylow theorems, fields and extensions, number fields, Galois correspondence.

Winter 2020 **Combinatorics**, *Intermediate Class*.
Binomial coefficients, double-counting; Stirling numbers; counting labeled trees

Art of Problem Solving (AoPS)

Summer 2023 **Group Theory**, Grade: A+.
Building groups from other groups, symmetries of geometric objects, constructing fields.

2020 – 2021 **Calculus**, Grade: A+.
Differentiation, integration, Taylor series, parametric curves, polar coordinates.

Spring 2023 **Intermediate Programming with Python**, Grade: A+.
Recursion, object-oriented programming, graphical user interfaces, event-driven programming

Self Study

Fall 2021 **Topology**, *James Munkres*.
Topological spaces, connectedness, compactness, separation axioms; Tychonoff theorem.

Fall 2020 **Linear Algebra**, *Kenneth Hoffman & Ray Kunze*.
Polynomial ideals, elementary canonical forms, inner product spaces, spectral theory.