

Aryan Hemmati

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Education

Mirza Koochak Khan NODET Highschool, Diploma in Mathematics and Physics Sep 2018 – Jun 2021

- GPA: 19.73/20

Sharif University of Technology, BSc in Pure Mathematics Sep 2021 – Jan 2026 (Exp.)

- GPA: 17.16/20

- **Coursework:** Algebraic Topology, Manifold Geometry, Complex Analysis, Measure Theory, Special Relativity, General Relativity, Étale Cohomology Seminar, Hyperbolic Dynamics Seminar, Mirror Symmetry Seminar
- **Audited Courses:** Riemann Surfaces, Algebraic Geometry, Group Schemes, Algebraic Number Theory, Class Field Theory, p-Adic Hodge Theory, Differential Geometry, Differential Topology

Experiences & Research Projects

- **Moduli Space of Vector Bundles and Stability Analysis:** Bachelor Project with Prof. Bahraini

I am currently doing my bachelor project with Prof. Bahraini on Geometric Invariant Theory and moduli space of vector bundles, focusing on construction of Grothendieck's Quot schemes, slope stability of vector bundles and Kempf-Ness & Narasimhan-Seshadri theorems. I'm currently writing my thesis on this project and it's yet to be completed. A draft is available [here](#).

- **On A Noncommutative Analogue of The Fundamental Group:** Research Project with Prof. van Suijlekom

Throughout this project I learned a great deal about noncommutative geometry and differential graded algebras. The main source for this project was [a paper by Prof. van Suijlekom](#). As a goal to this project, I am currently trying to compute the introduced fundamental group for a more general family of noncommutative spaces.

Awards and Events

- **IPM Winter School on Algebraic Geometry & Number Theory:** A collection of three short courses given by IPM
- **IPM Conference on Moduli Spaces:** Series of talks about moduli problems, algebraic stacks and other topics
- **IPM Conference on Elliptic Curves:** Series of talks on elliptic curves, modularity and isomorphism problems
- **BICMR-IPM Conference on Geometry and Topology:** A series of talks on various topics of topology
- **13th Biennial Seminar on Geometry and Topology:** A series of talks on various topics of topology
- **Silver Medal in the Iran's Mathematical Olympiad 2019:** Rank 18
- **Gold Medal in IMS contest 2024:** Rank 4

Presentations

- **On A-Model and B-Model Correlation Functions of The Quintic Threefold:** On the enumerative predictions of mirror symmetry on the number of rational curves of genus zero and fixed degree on a quintic threefold, by calculating the Yukawa couplings of the quintic threefold and its mirror, using Gromov-Witten invariants
- **Mapping Class Group and Nielsen-Thurston Classification Theorem:** Notes available [here](#)
- **Dessins d'Enfants and the Absolute Galois Group of Rationals:** Notes available [here](#)
- **On Furstenberg Transformation of the Torus:** On minimal but not uniquely ergodic diffeomorphisms
- **Graph embeddings and proof of Heawood coloring conjecture:** Notes available [here](#)
- **A New Approach to P vs. NP: Geometric Complexity Theory:** Following a series of papers by K.D. Mulmuley
- **Elementary Proof of Hartogs Extension Theorem:** As a part of complex analysis course by Prof. Alireza Bahraini
- **Node Connectivity Augmentation of Highly Connected Graphs:** Notes available [here](#)
- **Coloring Discrepancy and Applications:** Notes available [here](#)
- **Continuous Geometry:** On axiomatizations of geometry, Von Neumann's work and Coordinatization theorem
- **Basic techniques on Principal Component Analysis:** As part of lectures on the Advanced Programming course. Notes, workshop video and all the relevant content are available [here](#) and [here](#).

Teaching Experience

- **Differential Topology:** Teaching Assistant
- **General Topology:** Teaching Assistant
- **Advanced Programming:** Teaching Assistant
- **IMO Preparation courses:** Head of number theory team in Iran IMO summer camp

Relevant Studies

During my bachelor years, I organized and participated in several study groups and seminars where we all studied several chapters of a book and gave presentations on them. The topics include:

- **Geometric Invariant Theory by D. Mumford, et al. (along with numerous articles):** Bachelor project
- **Noncommutative Geometry and Particle Physics by W.D. van Suijlekom:** Research project
- **Lectures on DGA's and noncommutative geometry by M. Dubois-Violette:** Research project
- **Mirror Symmetry and Algebraic Geometry by D.A. Cox:** Course by Prof. A. Rastegar
- **Notes on p-Adic Hodge Theory by O. Brinon, B. Conrad:** Course in IPM (given by S. Gholami)
- **Ordered Groups and Topology by A. Clay, D. Rolfsen:** Self study under supervision of Prof. A. Kamalinejad
- **Hyperbolic Dynamics:** Course in IPM (descriptions [here](#))
- **Group Schemes by W.C. Waterhouse:** Course in IPM (given by A. Partofard)
- **Class Field Theory by J. Anschütz:** Course in IPM (given by E. Shahoseini)
- **Algebraic Number Theory by J. Neukirch:** Study group in IPM (supervised by S. Gholami)
- **Introduction to Non-Archimedean Geometry by P. Achinger:** Seminar on Rigid Analytic Geometry
- **Fourier–Mukai transforms in Algebraic Geometry by D. Huybrechts:** Seminar on derived categories
- **Spacetime and Geometry, An Introduction to General Relativity by Sean M. Carroll :** General relativity course
- **Knot Theory by K. Reidemeister:** Personal study

Voluntary Activities

- **Problem-Solving Sessions for Calculus I,II, Differential equations:** Held midterm/final preparation sessions
- **Graph embeddings; An introduction to the theory of Dessins d'Enfants:** On graph embeddings and Dessins and their application to solving Pell equations. I also wrote a long expository note on this topic which was published in "Pargar" -a journal for Iranian undergraduate and high school students. The note is available [here](#).
- **An introduction to Hasse-Weil Bound:** A series of elementary notes on the Hasse-Weil bound written and published in Pargar for high school students, starting from the weak version of Hasse-Weil bound on hyperelliptic curves and aimed to go all the way through the Lang-Weil bound. The note is available [here](#).
- **A brief introduction to Topological Fixed Point Theory:** On history of fixed point theory and giving a combinatorial proof to Brouwer fixed point theorem. This talk was given to high school students (slides available [here](#))
- **Introduction to Lattice Theory:** A short course about lattice theory and related methods in elementary number theory through Minkowski theory and geometry of numbers. This course was given to high school students
- **Takeya needle problem; revisiting the concept of area:** An elementary talk about Takeya needle problem in 2D and 3D and related results by introducing concepts of measure and going through Perron method of creating Takeya sets of arbitrarily small measure and ending with a proof of the zero measure case (slides available [here](#))

Technical Skills & Experience ([LinkedIn](#), [GitHub](#))

- **Java, Python, \LaTeX Programming:** Advanced
- **Go Programming:** Intermediate
- **Part-time junior software engineer in Balad**
- **Part-time optimization engineer in Reverso**

Languages

- **Persian:** Native
- **English:** Proficient
- **German:** Intermediate