

# Aryan Hemmati

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## Education

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| <b>Sharif University of Technology</b> , BA in Pure Mathematics | Sep 2021 – Jan 2026 (Exp.) |
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- **Coursework:** Algebra I, Analysis I, II, Topology, Algebraic Topology, Manifold Geometry, Complex Analysis, Measure Theory, Real Analysis, Commutative Algebra (audit at IPM), Riemann Surfaces (audit at UT), Algebraic Geometry, Group Schemes, Algebraic Number Theory, Class Field Theory, Special Relativity, General Relativity, K-theory seminar (Étale Cohomology), Hyperbolic Dynamics (audit at IPM)
  - GPA: 17.25/20

## Teaching Experience

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- **General Topology:** Teaching Assistant  
During the spring semester of 2024, I worked as an assistant to Prof. Bahraini. I was tasked with holding TA classes, where I discussed complementary topics such as Kuratowski fan space and projective limit topology (some of the notes are available [here](#)).
  - **Advanced Programming:** Teaching Assistant  
I was a teaching assistant of Dr. Boomeri during the spring semesters of 2023, 2024 and 2025. I designed the final project of the course, where I tried to focus on computational geometry and multi-threading while addressing issues of graphical workflow, concurrency, and optimization. The project documentations of several phases are available [here](#). Related codes and workshops are also available [here](#) and [here](#).
  - **IMO Preparation courses:** Head of number theory team in Iran IMO summer camp  
I have had numerous experiences teaching high school students contest-level mathematics and helping them master problem-solving skills required to participate in mathematical competitions such as IMO (International Mathematical Olympiad). I have also held problem-solving sessions on AOPS and IYSC. I was the head of the number theory team in IYSC where I gave lectures on analytical number theory, Dirichlet characters, Pólya-Vinogradov inequality, and various inequalities on  $\mathbb{R}$ . Some of my notes for the talks and relevant details are available [here](#).
  - **Differential Topology:** Teaching  
During the spring semester of 2025, I worked as an assistant and held problem solving sessions mostly on the final topics of the course including oriented intersection number, cobordism theory and Thom space. I also helped with grading the students' assignments.

## Experiences & Research Projects

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- **Moduli Spaces of Bundles and Stability Analysis:** Bachelor Project with Prof. Bahraini  
I am currently doing my bachelor project with Prof. Bahraini on Geometric Invariant Theory and symplectic geometry, focusing on concepts of 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.

## 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
- **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

## Presentations

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- **Mapping Class Group and Nielsen-Thurston Classification Theorem:** An expository talk about the background and proof of this theorem, given as a part of Hyperbolic Dynamics seminar at IPM (notes available [here](#))
- **Dessins d'Enfants and the Absolute Galois Group of Rationals:** A thorough explanation to the theory of Dessins d'Enfants and their Galois actions on the absolute Galois group of rational numbers (notes available [here](#))
- **Continuous Geometry:** On axiomatizations of geometry, Von Neumann's work and Coordinatization theorem
- **On Furstenberg Transformation of the Torus:** On minimal but not uniquely ergodic diffeomorphisms and Furstenberg construction, given as a part of the Geometry and Topology Seminar organized by Prof. Amin Talebi
- **Elementary Proof of Hartogs Extension Theorem:** As a part of complex analysis course by Prof. Alireza Bahraini
- **A New Approach to P vs. NP: Geometric Complexity Theory:** On new approaches to complexity problems via algebraic geometry and representation theory
- **Node Connectivity Augmentation of Highly Connected Graphs:** Expository talk on a paper of the same name, as a part of a seminar on algorithm and computation organized by Prof. Morteza Alimi (notes available [here](#))
- **Graph embeddings and proof of Heawood coloring conjecture:** A presentation given in a seminar on graph theory organized by Prof. Javad Ebrahimi (notes available [here](#), along with some preliminaries and problems)
- **Coloring Discrepancy and Applications:** On different bounds and techniques for coloring discrepancy problem as a part of the Combinatorial Optimization course by Prof. Morteza Alimi (notes available [here](#))
- **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](#).

## Awards and Events

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- **IPM Winter School on Algebraic Geometry & Number Theory:** A collection of three short courses given by IPM
- **IPM Conference of Moduli Spaces:** A series of talks about moduli problems, algebraic stacks and other topics
- **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

## Voluntary Activities

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- **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:** A basic talk on graph embeddings and Dessins and their application to solving Pell equations. This talk was given to high school students. 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
- **Kakeya needle problem; revisiting the concept of area:** An elementary talk about Kakeya needle problem in 2D and 3D and related results by introducing concepts of measure and going through Perron method of creating Kakeya sets of arbitrarily small measure and ending with a proof of the zero measure case (slides available [here](#))

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

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

## Languages

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