# Abbas Mammadov

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## Research interests

**Generative Models, Diffusion Models, Geometric Deep Learning, Inverse Problems, AI4Science**
*Learning (un)structured data distributions lying on arbitrary manifolds. Solving intricate inverse problems.*

## Education

**Korea Advanced Institute of Science and Technology (KAIST)** Daejeon, Korea
*BSc. in Computer Science and Mathematics - cGPA: 4.04/4.3 (97.4/100)* *Aug. 2020 - Feb. 2025 (Expected)*

## Publications

**[P6] Diffusion-Based Inverse Solver on Function Spaces With Applications to PDEs**
**Abbas Mammadov**, Julius Berner, Kamyar Azizzadenesheli, Jong Chul Ye, Anima Anandkumar
*Machine Learning and the Physical Sciences Workshop, NeurIPS 2024*

**[P5] Amortized Posterior Sampling with Diffusion Prior Distillation**
**Abbas Mammadov***, Hyungjin Chung*, Jong Chul Ye
*preprint (under review)*

**[P4] Geometric Diffusion Models for Data Over Arbitrary Manifolds**
Byeongsu Sim*, **Abbas Mammadov***, Moo K. Chung, Jean-Jacques Slotine, Jong Chul Ye
*preprint (under review)*

**[P3] Defining Neural Network Architecture through Polytope Structure of Dataset**
Sangmin Lee, **Abbas Mammadov**, Jong Chul Ye
*International Conference on Machine Learning, ICML 2024,* ***Spotlight top 3.5%***

**[P2] Artificial Barber: Hair Color and Style transfer using GANs**
**Abbas Mammadov**, Kaleb Mesfin Asfaw
*Korea Software Congress, KSC 2023 (Oral)*

**[P1] Data Geometry and Topology dependent bounds on deep ReLU network widths**
Sangmin Lee, **Abbas Mammadov**, Jong Chul Ye
*Korean Society for Industrial and Applied Mathematics, KSIAM 2023 (Best Poster)*

## Experience

**Anima AI + Science Lab, Caltech** Jun. 2024 - Present
Research Intern (Supervised by Prof. Anima Anandkumar)

- Researching on Neural Operators, Diffusion Models, and Inverse Problems on Infinite Dimensions

**BioImaging, Signal Processing & Learning Lab (BISPL), KAIST** Jan. 2023 - Present
Research Intern (Supervised by Prof. Jong Chul Ye)

- Researching on Schrödinger Bridge Problem and Diffusion Models, generalizing them to Riemannian manifolds
- Solving intricate inverse problems through the application of statistical inference methods
- Analyzing deep neural networks and finding relations with the underlying data geometry & topology

**KAI Inc.** Jun. 2022 - Dec. 2022
Machine Learning Engineer

- Achieved 90 mAP and 100 FPS (10ms) inference by developing and end-to-end lightweight models on noisy Railway & Catenary abnormality detection datasets, which have been applied to entire subway stations of Daejeon city
- Deployed the models by developing TCP-based control software on PyQt Graphical User Interface (GUI)

## Projects

**Hair Color and Style GAN (GitHub repo)(paper link)** Fall 2022

- Achieved *1st place among 25 teams* by conducting a research project on hair color and style change in which utilized cutting-edge styleGAN architecture and II2S embeddings to achieve realistic and visually appealing results
- Implemented novel techniques to enable customized color options for users, while achieving comparably fast inference times without sacrificing quality, resulting in a highly personalized and efficient user experience

**Empathetic Dialogue Generation (paper link)** Spring 2022

- Improved the results of sota model "CEM:Commonsense-aware Empathetic Response Generation", to achieve both affection and cognition aspects of empathy on dialogue generation
- Designed successful ablation studies and novel ideas, which improved benchmark results (perplexity) by integrating diverse attributes. Ranked as the *best research paper among 52 teams*

**Facial Expression Recognition (GitHub repo)** Spring 2022

- Implemented baseline models of ResNet and EfficientNet on a dataset consisting of grayscale human faces to recognize human facial patterns independent of age, appearance, and ethnicity
- Achieved competitive results over baseline models by addressing overfitting and utilizing data augmentation & transfer-learning techniques

## Awards

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| Excellent Teaching Assistant (TA) Award | Mar. 2024 |
| KAIST Q-day Award (Advanced Research) | Nov. 2023 |
| CoE Leadership Award (Research Excellence) | Aug. 2023 |
| Dean's List (Top 3% of College of Engineering) | Aug. 2023 |
| Qualcomm Innovation Award (QIA) | Jun. 2023 |
| Simon Marais Mathematics Competition – Top Quartile | Oct. 2021 |
| International Mathematical Olympiad (IMO) – Honorable Mention | 2020 & 2019 |
| Asian Pacific Mathematical Olympiad (APMO) – Silver Medal | May. 2020 |
| Caucasus Mathematical Olympiad (CMO) – Gold Medal | Mar. 2020 |
| National Science Olympiad (Mathematics) – Gold medal (First Of First) | 2020 & 2019 |

## Professional Service

**Math Olympiad Leader, Coordinator, and Coach** Sep. 2020 - Present

Ministry of Education of Azerbaijan Republic (https://abbasmammadov.github.io/olympiad)

- Conducting intensive training camps, preparing handouts, proposing problems, and teaching various topics
- Serving as a Leader at International venues (IMO, APMO, EGMO, BMO, JBMO, IMSC)
- Provided lectures on algebra at International Mathematics Summer Camp (IMSC)

## Teaching experience

**Teaching Assistant (TA), KAIST** Aug. 2022 - Present

- CS204: Discrete Mathematics (Fall 2024, instructor: Jinah Park)
- CS492: Unconventional Computing (Fall 2024, instructor: Martin Ziegler)
- CS492: Algorithms Design and Analysis for NP-Hard Problems (Spring 2024, instructor: Eunjung Kim)
- AI502: Deep Learning (Fall 2023, instructor: Jong Chul Ye)
- CS422: Computation Theory (Fall 2023, instructor: Martin Ziegler) (Excellent TA Award)
- CS492: FutureS of the World (Fall 2023, instructor: Martin Ziegler)
- CS300: Introduction to Algorithms (Fall 2022, instructor: Martin Ziegler)

**Tutor & Coach, KAIST** Aug. 2021 - Jun. 2023

- MAS101: Calculus I (Best Tutor Award)
- MAS201: Differential Equations and Applications

## References


**Jong Chul Ye** — Jan. 2023 - Present
Research Advisor — jong.ye@kaist.ac.kr

**Martin Ziegler** — Aug. 2022 - Present
Academic Advisor — ziegler@kaist.ac.kr

**Hyungjin Chung** — Jan. 2023 - Present
Mentor and Collaborator — hj.chung@kaist.ac.kr

**Seunghoon Hong** — Sep. 2022 - Dec. 2022
Project Supervisor — seunghoon.hong@kaist.ac.kr