

Karhan K. Kayan

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Education

The University of Chicago

Chicago, United States

B.S. IN COMPUTER SCIENCE, B.S. IN MATHEMATICS

Expected, June 2022

- Cumulative GPA: 3.77/4.00, Computer Science Major GPA: 3.86/4.00
- Relevant Graduate-Level Coursework: Machine Learning, Deep Learning, Theory of Machine Learning, Information and Coding Theory, Computer Vision, Real Analysis, Topological Data Analysis, Quantum Computing
- Relevant Undergraduate-Level Coursework: Honors Theory of Algorithms, Honors Combinatorics, Robotics, Computer Security, Computer Architecture, Operating Systems, Stochastic Processes, Honors Analysis in \mathbb{R}^n I-II-III, Honors Abstract Algebra I-II-III, Complex Analysis, Partial Differential Equations
- Honors/Awards: Dean's List (2018-2019), Quad Undergraduate Research Grant, Neubauer International Scholarship, University of Chicago Grant

Bahcesehir High School for Science and Technology

Istanbul, Turkey

DIPLOMA

June 2018

- Admission through the *Turkish High School Entrance Exam* (Placed 44th among 1,112,604 students).
- Cumulative GPA: 98.47/100
- Honors/Awards: High Honor Roll (2014-2018), Full Merit Scholarship (2014-2018)

Research Experience

Booth School of Business - Advisor: Prof. Bryon Aragam

Chicago, Illinois

GRAPHICAL MODELS, CAUSAL INFERENCE

June 2021 - Present

- Worked on fundamental and applied research in graphical models, causal inference, and generative machine learning models.
- Researched how Causal Inference can be used with Generative Adversarial Networks to ensure fairness in machine learning. Presented these findings at the Center for Data and Computing.
- Writing a paper exposing the current research in the field of graphical models, covering topics such as the basics of Bayesian Networks, Causal Inference methods, and different conditions for identifiability.
- Implemented various Variational Autoencoder architectures in PyTorch. Investigated how VAEs can be used for causal inference under latent confounding. Studied problems of statistical identifiability under these methods.

Jopa Lab - Advisor: Dr. John Paparrizos, Prof. Michael Franklin

Chicago, Illinois

SCALABLE CAUSAL INFERENCE FOR TIME SERIES

July 2020 - Present

- Implemented an accurate yet scalable framework in Python for representing, comparing, and indexing time series. Built this framework as a layer on top of Apache Spark. Published a standalone Python package called *grailts* for professional use.
- Used Python and C++ to implement a fast approximate k-nearest neighbors algorithm for learning time series representations that preserve more complex distances than the standard Euclidean Distance.
- Currently working on a paper to scale causal inference for time series to big datasets using this representation learning framework.

Research Experience for Undergraduates - Advisor: Dr. Minh-Tam Trinh, Prof. Peter May

Chicago, Illinois

ORTHOGONAL DECOMPOSITION OF MODULAR FORMS

June 2019 - Aug. 2019

- Worked on modular forms and analytic number theory for 3 months at the University of Chicago.
- Attended lectures on hyperbolic geometry, probability theory, and graph theory over the course of 8 weeks.
- Reviewed the literature on modular forms. Authored and published an *expository paper* on the orthogonal decomposition theorem of modular forms, drawing from a range of mathematical topics such as algebraic geometry, Fourier analysis, and group theory.

Work/Other Experience

NOVamedtek

Ankara, Turkey (Remote)

COMPUTER VISION INTERN

September 2021 - October 2021

- Wrote the image processing software of an Infrared Vein Visualization System from scratch. Implemented this software both in Python and C++ using OpenCV.
- Built an end-to-end pipeline, drawing from a wide range of computer vision techniques such as Histogram Equalization, Adaptive Thresholding, Morphological Transformation, and Contour Approximation.
- Worked with a team of electrical engineers to ensure real-life feasibility of the software.

NOVAmedtek

ROBOTICS INTERN

Ankara, Turkey

July 2018 - Aug. 2018

- Participated in the design of a commercial medical product called robotic ultrasound localization arm for lithotripter.
- Formulated a 5 joint, 6 degrees of freedom robotic arm attached ultrasound probe to calculate the coordinates of kidney stones indicated by ultrasound equipment with respect to the focal point of the lithotripter using forward kinematics.
- Implemented this formulation in C programming language to be used in the microcontroller of the product.

25th Balkan Olympiad in Informatics

Chisinau, Moldova

PARTICIPANT

July 2017

- Selected to the Turkish National team for the 25th Balkan Olympiad in Informatics, placing 4th, 5th, and 6th in the national team selection contests among top computer science students in Turkey.
- Participated in a two-day programming contest that involved solving algorithmic problems on various topics such as computational geometry, graph theory, and dynamic programming.

Honors & Awards

2017	4th Place , National Olympiad in Informatics First Round	Ankara, Turkey
2017	5th Place , National Olympiad in Informatics Second Round	Ankara, Turkey
2017	6th Place , National Olympiad in Informatics Team Selection Contest	Ankara, Turkey
2017	Silver Medal , Istanbul Science Olympiad (Informatics)	Istanbul, Turkey
2013	44th among 1,112,604 students , National High-school Entrance Exam	Turkey

Selected Writing

“Orthogonal Decomposition of Modular Forms” (Expository REU Paper) [pdf]	University of Chicago
KAYAN, KARHAN K.	2019
“Scalable Causal Inference for Time Series” (in progress)	University of Chicago
JOHN PAPARRIZOS, KARHAN K. KAYAN, MICHAEL J. FRANKLIN	2021
“Graphical Models and Structure Learning” (in progress)	University of Chicago
KARHAN K. KAYAN, BRYON ARAGAM	2021
“Topology Layers for cGANs and DCGANs” (Final Project TDA) [pdf] [code]	University of Chicago
KARHAN K. KAYAN	2021

Skills

Programming/IT	Python (Pytorch, Pandas, SciPy, Numpy, Scikit-Learn, tslearn), C/C++, Matlab, R (bnlearn, sparsebn), OpenCV, Haskell, Java, SQL, C#, \LaTeX , Linux, Assembly (x86), VMD (Visual Molecular Dynamics), NAMD, Mathematica
Languages	Turkish (Native), German (Elementary Proficiency), Russian (Elementary Proficiency)

Talks

Center for Data and Computing, The University of Chicago	Chicago, Illinois
INTEGRATING GENERATIVE MODELS AND CAUSAL INFERENCE WITH APPLICATIONS IN FAIR MACHINE LEARNING	August 2021
Graphical Models Group, The University of Chicago Booth School of Business	Chicago, Illinois
GEOMETRY OF THE FAITHFULNESS ASSUMPTION IN CAUSAL INFERENCE	November 2021

Service

Bahcesehir High School for Science and Technology	Istanbul, Turkey
OLYMPIAD/PROGRAMMING MENTOR	September 2015 - February 2019
• Mentored 3 high school students for the National Olympiad in Informatics and tutored a more general population in programming.	
• Gave weekly lectures on C++ programming, competitive programming algorithms, and discrete mathematics.	