Mohsen Karkheiran

GitHub — LinkedIn — Streamlit — Publications

Summary

Ph.D. in Mathematical Physics with 4 years of research experience, offering a strong foundation in mathematical modeling, computational physics and problem solving, with extensive knowledge in data science and analytics. My portfolio of work showcases a broad array of Data Science and ML concepts, with a strong emphasis on application and value-add, demonstrating my ability to tackle industry-relevant challenges.I systematically and creatively use my skillset to add tangible value to the team, the business, and the end-user. I am constantly learning, and always looking to improve.

Skills

Machine Learnng : Linear Regression, Logistic Regression, Decision Trees, Random Forest, KNN, k-means, PCA, Association Rule Learning, Causal Impact Analysis , NetworkX, NLTK

Tools : Excel, Tableau, Github, Streamlit, AWS (S3, Lambda, IAM, EC2, SageMaker, RDS, DynamoDB, Glue), DataBricks

Deep Learning : Reinforcement Learning, Recurrent Neural Networks, Convolutional Neural Networks, Artificial Neural Networks, Physics informed Neural Networks, NLP, LLM(basic)

Programming : Python(Base, Pandas, Numpy, Matplotlib, seaborn, Scikit-Learn, SciPy, NetowrokX, NLTK, Keras, PyTorch), Julia, SQL, MongoDB , Mathematica , SageMath, MAGMA

Mathematics : Differential Equations, Linear Algebra, Statistics (Hypothesis Testing, AB Testing, Central Limit Theorem, Distributions), Algebraic Geometry/Topology, Differential Geometry, Category Theory

Physics : Classical/Statistical/Quantum Physics and Field Theory

Quantum Simulation : PennyLane, Qiskit

Work Experience

Postdoctoral fellow *Mathematical Physics*, University of Alberta, Edmonton, Alberta · · · · · · · · · 01/2023 - Now
Visiting researcher at University of Waterloo.

- Novel connections were derived between geometries and physical models using MAGMA and SageMath.

- Classified symmetries of geometrical spaces by CNNs and ANNs with an accuracy close to 98%.

Postdoctoral fellow *High Energy Physics*, Institute for Basic Sciences, · · · · · · · · · 10/2020 - 11/2022
Daejeon, South Korea

- Used numerical algebraic geometry in Mathematica to link polynomial rings' linear algebra with space geometry.

Data Science|Analytics Projects

Time Series in Finance : Applied **GARCH** and **ARIMA** to historical stock market data to forecast the future stock prices and volatilities. These data is used in another project for option pricing based on Black-Scholes-Merton model.

Hurricane Path Prediction : In this project six regression models (along with RNN models), Linear Regression, Stochastic Gradient Descent, Decision Tree Regressor, Random Forest Regressor, Gradient Boosting Regressor, and Support Vector Machine Regression, were applied to historical hurricane's data to predict the future coordinates of hurricanes.

Grocery Recommender : In this project we use **Association Rule Learning** to analyze the transactional relationships and dependencies between products in the alcohol section of a grocery store.

Impact of Membership : In this project we use **Causal Impact Analysis** to analyze and understand the sales uplift of customers that joined the new "Delivery Club" campaign.

Assessing a Campaign's Effect : In this project we apply **Chi-Square Test** For Independence (a Hypothesis Test) to assess the performance of two types of mailers that were sent out to promote a new service.

Customer Segmentation : In this project we use **k-means clustering** to segment up the customer base in order to increase business understanding, and to enhance the relevancy of targeted messaging and customer communications.

Sign-up Prediction : In project we use classification models such as k-means clustering, linear regression, decision trees and random forest to segment up the customer base of a grocery to predict which customers will sign up for online delivery system.

PCA Compression for Classification : To predict whether customers of a shop will buy a new music album, we used historical data of the same artist. To compress the feature space we used PCA.

Customer Loyalty Prediction :We use regression algorithms (linear regression, decision trees, random forest) to assign loyalty prediction to each customer. The historical data is used for training these modes.

Image Search Engine : By transferring **VGG16** architecture, we built a Deep Learning based Image Search Engine that will help customers find similar products to ones they want.

GitHub Portfolio : Many other projects that use **Deep Learning** techniques such as **RNN, CNN, ANN, PINN** in combination with **NLP**, **NetworkX**, and **Quantum Simulation** (Visit Github and Streamlit pages for updates).

Education

PhD *Mathematical Physics/String Theory*, Virginia Tech, Blacksburg, USA, 05/2020

Certifications

- Data Science Certificate, University of Waterloo (WatSpeed): Data Science, Statistics in Data Science, Machine leanrning, Big Data Management

- PINNs course University of Alberta (Prof. V. Putkaradze)

- Data Science Certificate, University of Michigan: Machine learning, NLP, Network Analysis.

Special Mention

- Rank 2 in national entrance exam for Ph.D program in physics between 5000 applicants, Iran, 2013

- Rank 6 in national national entrance exam for M.Sc program in physics between 6000 applicants, Iran, 2011

- Rank 368 in national national entrance exam for B.Sc programs between 10^5 applicants, Iran, 2007