

# S. Mohammad H. Hosseini Dastjæ

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## Research Interests

- Generative and Probabilistic ML
- Computer Vision
- Stochastic Calculus

## Education

- 🎓 **University of Isfahan** B.Sc. in Computer Engineering Sep 2019 - Jul 2023
- **Thesis & Internship Advisor:** Dr. Mahvash Mohamamdi   **Thesis Examiner:** Dr. Rezaie   **Thesis Grading:** 20/20
  - **Selected Courses:** Research & Presentation Methods: 19.61/20   Linear Optimization: 19.1/20 (**Math Dept.**)   Linear Control: 20/20   Pattern Recognition: 15.84/20 (**Grad CE**)   Advanced Programming: 20/20   Robotics Lab: 20/20   Compiler Design: 19.5/20   Embedded Real-time Systems: 19.5/20   Computer Networks: 18.72/20   Computer Aided System Design: 19.44
- 🎓 **University of Isfahan** B.Sc. in Electrical Engineering Sep 2017 - Sep 2019
- **Changed Program to Computer Engineering**

## Publications

- Enhancing Meta Learning Retail Forecasting with Diffusion** (Submitted to EJOR) S Barak, S M Hosseini Dastjæ
- Proposed the use of generative features for time-series forecasting, while resulting in SOTA performance.
  - Demonstrated that score-based generative features outperform both deep learning and classical statistical features in robustness and explainability.
- Boosting SDE Framework of Generative Models towards Time-series Data** (In Preparation) S M Hosseini Dastjæ, S Barak
- Exploring bridging mechanisms (distribution to distribution) in generative modeling, focusing on approaches inherently tailored to time-series data.

## Experiences

### Research Experience 🔍

- Generative Models in Time-series Data and Business Analytics** (Mar. 2023 - Pres). Research Assistant
- Enhancing forecasting and generation of time-series data under the supervision of **Dr. Barak** from **University of Southampton**.
  - Developed the time-series generation and time-series generative feature extractor for MetaTS package (SDE agnostic generative model).
  - Supervision of current research on new conditional generative models in time-series data to build better generative forecasters.
- Image Enhancement via Generative Modeling in Accessibility Systems** (Dec. 2022 - Jul. 2023) B.Sc. Thesis
- Analysis of different generative models such as **Diffusion** and **Flow-based** on the image enhancement task.
  - Implemented a **VAE**-based method (**LUD-VAE**) to generate corrupted images for down the line coupled-input tasks.
  - Applied Denoising Diffusion Probabilistic Model **DDPM** and Low Light Flow **LLFlow** for restoring image corruption.
- Score-based Generative Modeling** (Course) Pattern Recognition
- Developed a generative model using **Score-matching Langevin Dynamics** to generate synthetic images, tested on **CIFAR-10**.
  - Implemented **SDE-based** generative diffusion, for producing novel images from noise, demonstrated on **Church Dataset**.
  - Trained score-based diffusion models with **Maximum Likelihood Estimation**, enhancing model ability on **MNIST**.
- Variational Inference** (Course) Research & Presentation
- Conducted a **survey on Variational Inference** methods, including **Black Box** and **Stochastic Variational Inference** and gave multiple presentations on the topic.
  - Worked with *Implicit Reparameterization of Gradients* and implemented **Mean Field** and **Automatic Differentiation** Variational Inference techniques.

### Industry Experience 🧠

- Machine Learning Intern** Partotech Samaneh
- Sentiment analysis of user feedback using **BiLSTM**.
  - Developed a pipeline for semantic extraction of newspaper articles by integrating **YOLO** and **BERT**-based models. Mar 2022 - Oct 2022

### Teaching Experience 👨🏫

- Online Instructor** University of Isfahan
- Chosen by the faculty of CE as the **instructor** for an **online course on deep learning**
  - Covered fundamentals of deep learning in computer vision and natural language processing
  - Tutorials on basic and advanced models such as VAEs, GANS, Normalizing Flows and Deep Equilibrium models. Winter 2022

## Teaching Assistant

University of Isfahan

- Holding practicum lab classes, selection and grading of homework in **Advanced Programming** course taught by Prof. R. Ramezani.

Spring 2021

## Volunteer Work

**Mentorship** University of Isfahan Artificial Intelligence (UIAI) Community

University of Isfahan

- Acting machine learning and mathematics mentor for computer engineering students.
- Writing articles about **ML Theory** and **Pure Math in ML** in **UIAI Digest**.

Feb 2021 - Present

## Projects

### Generative Models *Implementation and Assessment of Different Approaches to Generative Modeling*

- Implementation of **Probabilistic** and **Implicit Denoising Diffusion Models**, generating samples from Oxford Flowers 102.
- Generation of images based on CIFAR-10 dataset using an **autoregressive model**, PixelCNN.
- Data generation with the **Normalizing Flows** approach by implementation of Real NVP.
- Evaluation of **GANs** as an implicit generative model and **Energy-based GANs** as a solution to some of their shortcomings.
- Implementation of likelihood generative models, **Variational Auto Encoder**, an approach to a regularized latent space.

### Scheduling *Project for Real Time Systems Course*

- Posing scheduling in real time operating system as *Job Shop Scheduling* problem and using meta-heuristic methods as a solution.
- Presenting **Deep Lagrangian Networks** and *Genetic Algorithms* as solutions to the job shop scheduling problem.

### Artificial Intelligence Algorithms *Project for Artificial Intelligence Course*

- *Exploratory Data Analysis* on different datasets.
- Implementation of **Permutation Genetic Algorithm** and introduction of **Deletion Mutation** to generate best permutation subset of set.
- Developed an efficient agent for a non-deterministic grid-based scenario with constraints by implementing **Q-Learning**
- Implementation of **Value Iteration** as a solution to **Markov Decision Processes** modeling of large grid-based scenarios with constraints.

### Deep Learning Projects *Other projects that utilized deep learning approaches as solutions*

- Built the Vision Transformer (**ViT**) from scratch as a foundational model for attention-based image tasks, tested on the *CIFAR-10* dataset.
- Implemented Graph Attention (**GAT**) and Graph Convolution (**GCN**) for graph classification, using the *Cora* dataset.
- Applied **Dropout** to capture uncertainty in neural network predictions, demonstrated on the *MNIST* dataset.
- Utilized Text-to-Text Transfer Transformers (**T5**) for summarizing textual data, experimented on the *CNN/Daily Mail* dataset.

### Machine Learning Projects *Projects with more classical machine learning methods*

- Used **Persistent Homology** to analyze image structures for shape classification.
- Implemented **K-Means**, **K-Modes**, and **Spectral Clustering** for data segmentation, including customer grouping.
- Developed **Fuzzy C-Means** for soft clustering in overlapping datasets.
- Applied **Gaussian Process Regression** for to model uncertainty in regression outcomes.
- **Support Vector Machine classifier** for linearly and non-linearly separable data.
- Created an Optimal Bayes Classifier using density estimation.

## Certifications and MOOCs

Deep Learning Specialization (DeepLearning.AI)	Intro to Machine Learning (Kaggle)	Analysis I (AUT)
Probabilistic Graphical Models Specialization (Stanford)	Intermediate Machine Learning (Kaggle)	Analysis II(AUT)
Artificial Intelligence (IPM)	Feature Engineering (Kaggle)	Topology (SUT)
Machine Intelligence (Waterloo)	Sharif Neuroscience (SNS)	Algebra (Harvard)
Deep Learning (NYU)	Machine Learning (Stanford)	Abstract Linear Algebra (SUT)
Probabilistic Machine Learning (Tubingen)	Learning from Data (Caltech)	Probability Theory (Max Planck)
Probabilistic Systems (MIT)	Probability (Harvard)	Stochastic Processes (Leipzig)

## Skills and Familiarities

<b>Programming</b>	Python, Java, C++
<b>Frameworks and Libraries</b>	PyTorch, PyTorch Lightning, GPyTorch, TensorFlow Probability, TensorFlow, JAX, Scikit-Learn
<b>Statistical Inference</b>	Belief Propagation, Markov Chain Monte Carlo , Variational Inference
<b>Generative Models</b>	Energy Based Models, Flow Models, Diffusion Models, Score-based Models, Variational Models
<b>Machine Learning</b>	Reinforcement Learning, Support Vector Machines, Probabilistic Graphical Models, Gaussian Processes
<b>Deep learning</b>	Autoencoders, CNN, RNN, GNN, LSTM, Attention Models
<b>Dimensionality Reduction</b>	PCA, LDA, Isomap, LLE, t-SNE, ICA