MAHDI KOOSHKBAGHI

Machine Learning Engineer & Computational Scientist

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TECHNICAL SKILLS

Machine Learning

Deep Learning
Python, Tensorflow, JAX, Flax
Statistical & Bayesian Inference
NumPyro, PYMC
Generative AI
Gemini, OpenAI APIs
Database | SQL

Cloud Computing

Google Cloud Platform
BigQuery | Vertex AI
Cloud-Native Backend
FastAPI | Firestore | CloudRun

MLOps Infrastructure

Docker
Kubernetes, Kubeflow
Git | GitHub CI/CD

Scientific Computing

Unix | Fortran | LaTeX

REFERENCES

- **Christopher Curro**
  ccurro@estee.com
  Principal Data Scientist
  The Estée Lauder Companies
- **Eric Higgins**
  ehiggins@estee.com
  Data Science Executive
  The Estée Lauder Companies
- **Prof. Justin. B. Kinney**
  jkinney@cshl.edu
  Cold Spring Harbor Laboratory
- **Prof. Yannis Kevrekidis**
  yannisk@jhu.edu
  Johns Hopkins University
- **Dr. Christos E. Frouzakis**
  cfrouzakis@.ethz.ch
  Senior Scientist
  ETH Zürich

ABOUT ME

As a seasoned machine learning scientist with over 10 years of experience, I specialize in developing and deploying production-scale ML systems that bridge theoretical innovation with practical business value. My expertise spans the full ML lifecycle, from research to production deployment and monitoring. I have a proven track record of leveraging advanced techniques in deep learning, Bayesian modeling, and physics-informed ML to solve complex technical challenges at scale.

Key Technical Leadership & Impact:

- *Architected and led the implementation of enterprise-scale ML systems using state-of-the-art frameworks (TensorFlow, JAX) and cloud infrastructure (GCP, VertexAI), with expertise in scalable MLOps practices including KubeFlow orchestration.*
- *Deep expertise in probabilistic modeling and Bayesian inference using PyMC and NumPyro.*
- *Distinguished research background with 20+ publications in prestigious journals across machine learning, computational biology, and physical sciences, demonstrating ability to innovate in complex technical domains.*
- *Extensive experience in building and deploying containerized ML applications using Docker and Cloud Run, with strong focus on reproducibility and production reliability.*

EXPERIENCE

Staff Machine Learning Engineer | The Estée Lauder Companies

Nov 2022 – present | New York City, NY, USA

- Deployed Kubeflow pipelines for customer lifetime value (CLV) prediction and causal inference modeling (ATE estimation) using JAX/NumPyro Bayesian frameworks. Optimized promotion strategies, reducing excessive discounting and generating measurable cost savings (deployed Feb 2024).
- Contributed to the development of an agentic AI chatbot for enterprise use, integrating retrieval-augmented generation (RAG) and Graph RAG on a GCP stack (Firestore, Cloud Run). Designed with granular access controls, production monitoring via Cloud Logging, and modern web frameworks (FastAPI, HTMX).
- Mentored four interns on interpretable ML projects, leading to a 100% conversion rate to full-time roles, with two now reporting directly to me.
- Contributed to CI/CD automation for development and deployment, leveraging GitHub Actions to streamline workflows and ensure robust integration/testing processes.

Computational Postdoc | Cold Spring Harbor Laboratory

Jan 2020 – Nov 2022 | Cold Spring Harbor, NY, USA

- Developed TensorFlow-based software to analyze Massively Parallel Reporter Assay (MPRA) data: Ref. [6]
- Implemented Bayesian inference models for drug interaction analysis using CPU/GPU computing: Ref. [1]
- Developed computational frameworks for processing and analyzing raw biological datasets: Ref. [5]

Research Fellow in Applied Mathematics | Princeton University

March 2017 – Jan 2020 | Princeton, NJ, USA

- Led physics-informed machine learning research in collaboration with Johns Hopkins and Brown Universities under DARPA AIE grant: Refs. [2, 4]
- Developed manifold learning algorithms to analyze time-dependent datasets and extract governing equations: Refs. [3, 10, 11, 12, 14]
- Mentored graduate students in developing manifold learning and machine learning software.

EDUCATION

Doctor of Sciences | ETH Zürich

2012 – 2015 | Zürich, Switzerland

- Developed algorithms for computational fluid dynamics simulations of reactive flows: Refs. [15, 18, 19]
- Implemented nonlinear dynamics and bifurcation analysis tools for high-dimensional ODE systems: Ref. [16]
- Secured fully funded Early Postdoc Mobility grant from Swiss National Science Foundation (SNSF) for research at Princeton University.

Master of Science Mech. Eng | Amirkabir University of Technology

2008 – 2011 | Tehran, Iran

- Developed a time-accurate algorithm for low-Mach number variable-density flows on curvilinear grids: Ref. [20]

Bachelor of Science Aero. Eng | Amirkabir University of Technology

2008 – 2010 | Tehran, Iran

Bachelor of Science Mech. Eng | Amirkabir University of Technology

2004 – 2008 | Tehran, Iran

- Ranked 471st among 500,000 students in Iran's national university entrance examination.

Journal Articles

[1] Yuma Ishigami, Mandy S Wong, Carlos Marti-Gomez, Andalus Ayaz, **Mahdi Kooshkbaghi**, Sonya M Hanson, David M McCandlish, Adrian R Krainer, and Justin B Kinney. "Specificity, synergy, and mechanisms of splice-modifying drugs". In: *Nature Communications* 15.1 (Feb. 2024), p. 1880. DOI: 10.1038/s41467-024-46090-5.

[2] Elham Kiyani, **Mahdi Kooshkbaghi**, Khemraj Shukla, Rahul Babu Koneru, Zhen Li, Luis Bravo, Anindya Ghoshal, George Em Karniadakis, and Mikko Karttunen. "Characterization of partial wetting by CMAS droplets using multiphase many-body dissipative particle dynamics and data-driven discovery based on PINNs". In: *Journal of Fluid Mechanics* 985 (Apr. 2024), A7. DOI: 10.1017/jfm.2024.270.

[3] Nikolaos Evangelou, Noah J Wichrowski, George A Kevrekidis, Felix Dietrich, **Mahdi Kooshkbaghi**, Sarah McFann, and Ioannis G Kevrekidis. "On the parameter combinations that matter and on those that do not: data-driven studies of parameter (non)identifiability". In: *PNAS Nexus* 1.4 (Sept. 2022). ISSN: 2752-6542. DOI: 10.1093/pnasnexus/pgac154.

[4] Elham Kiyani, Steven Silber, **Mahdi Kooshkbaghi**, and Mikko Karttunen. "Machine-learning-based data-driven discovery of nonlinear phase-field dynamics". In: *Physical Review E.* 106 (6 Dec. 2022), p. 065303. DOI: 10.1103/PhysRevE.106.065303.

[5] Chirangini Pukhrambam, Vadim Molodtsov, **Mahdi Kooshkbaghi**, Ammar Tareen, Hoa Vu, Kyle S Skalenko, Min Su, Zhou Yin, Jared T Winkelman, Justin B Kinney, et al. "Structural and mechanistic basis of σ-dependent transcriptional pausing". In: *Proceedings of the National Academy of Sciences* 119.23 (2022), e2201301119. DOI: 10.1073/pnas.2201301119.

[6] Ammar Tareen, **Mahdi Kooshkbaghi**, Anna Posfai, William T Ireland, David M McCandlish, and Justin B Kinney. "MAVE-NN: learning genotype-phenotype maps from multiplex assays of variant effect". In: *Genome Biology* 23.1 (2022), pp. 1–27. DOI: 10.1186/s13059-022-02661-7.

[7] Carola J Maturana, Jessica L Verpeut, **Mahdi Kooshkbaghi**, and Esteban A Engel. "Novel tool to quantify with single-cell resolution the number of incoming AAV genomes co-expressed in the mouse nervous system". In: *Gene Therapy* (2021), pp. 1–6. DOI: 10.1038/s41434-021-00272-8.

[8] Caroline Moosmüller, Christopher J Tralie, **Mahdi Kooshkbaghi**, Zehor Belkhatir, Maryam Pouryahya, José Reyes, Joseph O Deasy, Allen R Tannenbaum, and Ioannis G Kevrekidis. "Periodicity Scoring of Time Series Encodes Dynamical Behavior of the Tumor Suppressor p53". In: *IFAC-PapersOnLine* 54.9 (2021), pp. 488–495. DOI: 10.1016/j.ifacol.2021.06.106.

[9] Liwei Zhuang, Peter Corkery, Dennis T Lee, Seungjoon Lee, **Mahdi Kooshkbaghi**, Zhen-liang Xu, Gance Dai, Ioannis G Kevrekidis, and Michael Tsapatsis. "Numerical simulation of atomic layer deposition for thin deposit formation in a mesoporous substrate". In: *AIChE Journal* 67.8 (2021), e17305. DOI: 10.1002/aic.17305.

[10] Felix Dietrich, **Mahdi Kooshkbaghi**, Erik M Bollt, and Ioannis G Kevrekidis. "Manifold learning for organizing unstructured sets of process observations". In: *Chaos: An Interdisciplinary Journal of Nonlinear Science* 30.4 (2020), p. 043108. DOI: 10.1063/1.5133725.

[11] Seungjoon Lee, **Mahdi Kooshkbaghi**, Konstantinos Spiliotis, Constantinos I Siettos, and Ioannis G Kevrekidis. "Coarse-scale PDEs from fine-scale observations via machine learning". In: *Chaos: An Interdisciplinary Journal of Nonlinear Science* 30.1 (2020), p. 013141. DOI: 10.1063/1.5126869.

[12] Thomas N Thiem, **Mahdi Kooshkbaghi**, Tom Bertalan, Carlo R Laing, and Ioannis G Kevrekidis. "Emergent spaces for coupled oscillators". In: *Frontiers in Computational Neuroscience* 14 (2020), p. 36. DOI: 10.3389/fncom.2020.00036.

[13] Luigi Acampora, **Mahdi Kooshkbaghi**, Christos E Frouzakis, and Francesco S Marra. "Generalized entropy production analysis for mechanism reduction". In: *Combustion Theory and Modelling* 23.2 (2019), pp. 197–209. DOI: 10.1080/13647830.2018.1504990.

[14] Alexander Holiday, **Mahdi Kooshkbaghi**, Juan M Bello-Rivas, C William Gear, Antonios Zagaris, and Ioannis G Kevrekidis. "Manifold learning for parameter reduction". In: *Journal of Computational Physics* 392 (2019), pp. 419–431. DOI: 10.1016/j.jcp.2019.04.015.

[15] **Mahdi Kooshkbaghi**, Christos E Frouzakis, Konstantinos Boulouchos, and Iliya V Karlin. "Spectral quasi-equilibrium manifold for chemical kinetics". In: *The Journal of Physical Chemistry A* 120.20 (2016), pp. 3406–3413. DOI: 10.1021/acs.jpca.6b01709.

[16] **Mahdi Kooshkbaghi**, Christos E Frouzakis, Konstantinos Boulouchos, and Iliya V Karlin. "n-Heptane/air combustion in perfectly stirred reactors: Dynamics, bifurcations and dominant reactions at critical conditions". In: *Combustion and Flame* 162.9 (2015), pp. 3166–3179. DOI: 10.1016/j.combustflame.2015.05.002.

[17] Ilya V Karlin, Shyam S Chikatamarla, and **Mahdi Kooshkbaghi**. "Non-perturbative hydrodynamic limits: A case study". In: *Physica A: Statistical Mechanics and its Applications* 403 (2014), pp. 189–194. DOI: 10.1016/j.physa.2014.02.018.

[18] **Mahdi Kooshkbaghi**, Christos E Frouzakis, Konstantinos Boulouchos, and Ilya V Karlin. "Entropy production analysis for mechanism reduction". In: *Combustion and Flame* 161.6 (2014), pp. 1507–1515. DOI: 10.1016/j.combustflame.2013.12.016.

[19] **Mahdi Kooshkbaghi**, Christos E Frouzakis, Eliodoro Chiavazzo, Konstantinos Boulouchos, and Iliya V Karlin. "The global relaxation redistribution method for reduction of combustion kinetics". In: *The Journal of Chemical Physics* 141.4 (2014), p. 044102. DOI: 10.1063/1.4890368.

[20] **Mahdi Kooshkbaghi** and Bamdad Lessani. "A collocated grid, projection method for time-accurate calculation of low-Mach number variable density flows in general curvilinear coordinates". In: *International Journal for Numerical Methods in Fluids* 72.3 (2013), pp. 301–319. DOI: 10.1002/fld.3734.

[21] Hossein Shokouhmand, M Fakoor Pakdaman, and **Mahdi Kooshkbaghi**. "A similarity solution in order to solve the governing equations of laminar separated fluids with a flat plate". In: *Communications in Nonlinear Science and Numerical Simulation* 15.12 (2010), pp. 3965–3973. DOI: 10.1016/j.cnsns.2010.01.031.