Kazem Meidani

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SUMMARY

I am a fifth-year PhD student at Carnegie Mellon University (CMU), and a graduate research assistant in Mechanical and Artificial Intelligence Lab (MAIL). During my PhD, I also worked with Electronic Arts as an AI Scientist Research Intern in EA AI Lab. My research primarily focuses on AI for mathematical and scientific understanding. Most of my works fall into the categories of:

- Deep Learning for Mathematical Understanding: Large Multi-modal Pre-training Models for Math and Numeric Reasoning, Generative Language Models for Mathematical Equations, Neural Symbolic Regression

- Deep Learning for Physics: Attention-based and Graph Neural Network Models for Learning Physical Systems, Machine Learning and Optimization for Scientific Discovery

EXPERIENCE

Graduate Research Assistant *Aug 2019 - Present*
Carnegie Mellon University *Pittsburgh, PA*
Research Assistant in Mechanical and Artificial Intelligence Lab (MAIL)

Selected Research Projects:
· Developed a **multi-modal pre-training model for math** via Symbolic-Numeric Integrated Pre-training (SNIP)
· Introduced a **Transformer-based planning** for symbolic expression generation using **pre-trained language models**
· Developed an **attention-based framework** (OFormer) for data-driven Neural Operator learning
· Developed **Graph Neural Network (GNN)** models for Molecular Dynamics and unstructured flow field data
· Introduced Machine Learning framework for identification of **Partial Differential Equations (PDEs)**
· Proposed an Integer Programming framework for identification of **dynamical systems** from videos
· Proposed **Reinforcement Learning (RL)** framework for online optimization algorithm selection

AI Scientist Intern *May 2022 - Aug 2022*
Electronic Arts *Redwood City, CA*
Internship in EA AI Lab, Research interest: ML and Deep Learning Frameworks in Sports Games

· Developed a Differentiable Physically-Based Model for inverse lighting optimization (200x faster computation)
· Introduced Deep Inverse Lighting model for lighting design of stadiums in sports games

EDUCATION

Carnegie Mellon University *Pittsburgh, PA*
Ph.D. in Mechanical Engineering (Artificial Intelligence) *2019 - May 2024 (Expected)*
M.Sc. in Mechanical Engineering GPA: 3.93/4.0
· Ph.D. Thesis Title (tentative): Deep Learning Symbolic Mathematics for Scientific Discovery

Sharif University of Technology *Tehran, Iran*
B.Sc. in Mechanical Engineering *2014 - 2019*
B.Sc. in Industrial Engineering GPA: 4.0/4.0

TECHNICAL SKILLS

Programming	Python, MATLAB, C/C++
ML & Deep Learning	PyTorch, Tensorflow, Scikit-learn, SciPy
Optimization	GUROBI, CVXPY

PUBLICATIONS

· *Transformer-based Planning for Symbolic Regression*
K. Meidani*, P. Shojaee*, AB. Farimani, C.K. Reddy. *Equal-contribution **NeurIPS 2023**

· *SNIP: Bridging Mathematical Symbolic and Numeric Realms with Unified Pre-training* **NeurIPS 2023 AI4Science**
K. Meidani*, P. Shojaee*, C.K. Reddy, AB. Farimani. *Equal-contribution *Submitted to ICLR 2024*

· *Transformer for Partial Differential Equations' Operator Learning*
Z. Li, **K. Meidani**, AB. Farimani. (2023) Transactions on Machine Learning Research (**TMLR**)

· *IP2: Identification of Parametric Dynamical Systems using Integer Programming*
K. Meidani, AB. Farimani. (2023) Expert Systems with Applications (ESwA)

· *Data-driven identification of 2D Partial Differential Equations using extracted physical features*
K. Meidani, AB. Farimani. (2023) Comp. Methods in App. Mech. and Eng. (CMAME)

· *Graph Neural Networks Accelerated Molecular Dynamics*
Z. Li, **K. Meidani**, P. Yadav, AB. Farimani. (2022) Journal of Chemical Physics (**JCP**)

· *Graph convolutional networks applied to unstructured flow field data*
F. Ogoke, **K. Meidani**, A. Hashemi, AB. Farimani. (2021) Machine Learning: Science and Technology (**MLST**)

· *Inverse Lighting with Differentiable Physically-Based Model*
K. Meidani, I. Borovikov, AB. Farimani, H. Chaput. (2023) **LION 17**

· *Titanium Carbide MXene for Water Desalination: A Molecular Dynamics Study*
K. Meidani*, Z. Cao*, AB. Farimani. (2021) *Equal-contribution ACS App. Nano Mat.

· *Online Metaheuristic Algorithm Selection*
K. Meidani, S. Mirjalili, AB. Farimani. (2022) Expert Systems with Applications (ESwA)

· *MAB-OS: Multi-Armed Bandits Metaheuristic Optimizer Selection*
K. Meidani, S. Mirjalili, AB. Farimani. (2022) Applied Soft Computing

· *Adaptive Grey Wolf Optimizer*
K. Meidani, AP. Hemmasian, S. Mirjalili, AB. Farimani. (2022) Neural Computing and Applications

· *VecMetaPy: A vectorized framework for metaheuristic optimization in Python*
AP. Hemmasian, **K. Meidani**, S. Mirjalili, AB. Farimani. (2022) Advances in Engineering Software

· *MeltpoolNet: Melt pool characteristic prediction in Metal Additive Manufacturing using machine learning*
P. Akbari, F. Ogoke, NY Kao, **K. Meidani**, CY Yeh, W Lee, AB Farimani. (2022) Additive Manufacturing

TEACHING AND PROFESSIONAL SERVICES

· Reviewer for Journals of Expert Systems with Applications, Applied Soft Computing, Applied Intelligence, IEEE Access, and PLOS ONE.
· Teaching Assistant at CMU for graduate course 'AI and ML for Engineers'.
· Teaching Assistant at Sharif University of Technology for 'Theory of Probabilities', 'Computer Information Science', and 'Thermodynamics'.

RELATED GRADUATE COURSES

- Introduction to Machine Learning
- AI and ML for Engineers
- Convex Optimization
- Probability and mathematical Statistics
- Deep Reinforcement Learning and Control
- Deep Learning for Engineers

HONORS AND AWARDS

- Ranked 1st in SRBench Competition 2023 (track 1) for Symbolic Regression.
- Ranked 1st in Industrial Engineering class of 2019 at Sharif University of Technology
- Ranked 2nd in Mechanical Engineering class of 2019 at Sharif University of Technology
- Ranked 7th in national exam for university entrance (2014)