Rohit Supekar

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Summary

I am an applied machine learning practitioner with a PhD from MIT focused on research in scientific machine learning, applied mathematics, and numerical computation, applied to problems in fluid dynamics. I have industry experience in the development of production-quality machine learning models tailored for constrained and multi-objective optimization problems. I have also been involved in deploying these models to cloud-based containerized applications for high throughput inference.

Education

Massachusetts Institute of Technology • Cambridge, MA 06/2017 – 07/2021
Ph.D. in Mechanical Engineering • GPA: 5/5
Advisor: Professor Jörn Dunkel, Applied Mathematics
Thesis: Learning and investigating phenomenological models for active matter

Massachusetts Institute of Technology • Cambridge, MA 09/2015 – 06/2017
S.M. in Mechanical Engineering • GPA: 5/5
Thesis on experimental and theoretical modeling of oceanic internal waves

Indian Institute of Technology, Madras • Chennai, India 08/2011 – 06/2015
B.Tech. in Mechanical Engineering • GPA: 9.4/10

Work Experience

The New York Times (Full-Stack) Senior Data Scientist 03/2023 – Present
(Full-Stack) Data Scientist 09/2021 – 02/2023

- *Model Development*
  - Developed real-time machine learning models for subscription-related problems, such as serving a paywall at optimal moments or personalizing messages for users to drive subscriptions
  - Trained causal machine learning and reinforcement learning algorithms such as contextual bandits on massive datasets with millions of rows
  - Translated complex business problems with constraints into multi-objective optimization problems
  - Leveraged statistical estimators to build robust backtesting and counterfactural estimation capabilities for prescriptive machine learning models
- *Model Deployment*
  - Deployed containerized machine learning models for high throughput and low latency applications using Tensorflow-Serving, NVidia Triton Inference Server, Docker, and Kubernetes
  - Wrote performant code in Python and Go in multiple production-grade monorepos across the company
  - Built batch ETL (Extract, Transform, and Load) pipelines to construct datasets for SQL databases using Apache Airflow
  - Managed my team's infrastructure on Google Cloud Platform (GCP) via CI/CD (Continuous Integration, Continuous Deployment) pipelines and Terraform (Infrastructure as Code)
- *Experimentation and Causal Inference*
  - Designed digital Randomized Control Trials (RCTs) to collect causally informative data for training machine learning models
  - Leveraged causal inference on observational datasets to infer the effect of paywalls on user behavior
- *Impact*
  - My work led to an additional hundreds of thousands of subscribers amounting to millions of dollars from subscription revenue
  - Authored technical blog posts and gave conference talks on my work on building batch models (see *this NYT Open Blog*, *this PyData conference talk*, or *this media interview with VentureBeat*)

Amazon | Data Science Intern, Level 5 06/2020 – 08/2020
Seattle, WA (virtual)

- Developed a causal machine learning model using double/de-biased machine learning to estimate the impact of Amazon Advertising products for sellers from observational data
- Utilized AWS EMR (Elastic MapReduce) clusters and PySpark for processing big data and distributed model training

Massachusetts Institute of Technology | Graduate Researcher and Teaching Assistant 09/2015 – 06/2021
Cambridge, MA

- Built a computational learning framework to infer macroscopic continuum models from microscopic trajectory data of active matter systems such as a collection of self-propelling particles or bacteria

- Leveraged differential programming in Julia to combine neural networks with differential equations to model reaction-diffusion systems
- Modeling complex fluid dynamical systems using theoretical analysis of the governing partial differential equations and parallelized numerical computation
- Published 7 research papers in top-tier journals
- Assisted the teaching curriculum of two courses across five semesters and led recitations and lectures for classes with 60-120 students (average teaching rating: 6.4/7)

Technologies

- Programming: Python, Go, Julia, MATLAB, SQL, VSCode
- Tools: Docker, Kubernetes, Apache Airflow, Google Cloud Platform, Linux, Shell scripting, Git/GitHub
- Packages: PyTorch, Tensorflow, Scikit-learn, PySpark, Pandas, NumPy, SciPy

Honors and Awards

- INMA Global Media Award – Second Prize for "Best Initiative to Acquire Subscribers" (Awarded to my project on machine learning for the paywall at The New York Times) 2023
- MathWorks Engineering Fellowship 2020
- MIT Graduate Student Council Travel Award 2020
- NSF Geophysical Fluid Dynamics Fellowship 2018
- WISE scholarship by DAAD (German Academic Exchange Service) 2014
- AICTE-INAE (Indian National Academy of Engineering) Travel Award 2014

Research Internships

Woods Hole Oceanographic Institution | Recipient of NSF–GFD Fellowship 06/2018 – 08/2018
Woods Hole, MA | Advisor: Professor Neil Balmforth, UBC Vancouver

- Pursued research on the topic of viscoplastic fluid dynamics using analytical and numerical tools

Leibniz University of Hannover | Recipient of DAAD-WISE Fellowship 06/2014 – 08/2014
Hannover, Germany | Advisor: Professor Karen Mulleners

- Performed experiments using tomographic Particle Image Velocimetry (PIV) on flow through lobed nozzles

Publications

9. R. Supekar, B. Song, A. Hastewell, A. Mietke & J. Dunkel, *Learning hydrodynamic equations for active matter from particle simulations and experiments*, Proceedings of The National Academy of Sciences (PNAS), 120, e2206994120 (2023)
8. S. Boury, R. Supekar, E. C. Fine, R. Musgrave, J. B. Mickett, G. Voet, P. Odier, T. Peacock, J. A. MacKinnon, & M. H. Alford, *Observations of Double Diffusive Staircase Edges in the Arctic Ocean* , J. Geophys. Res.: Oceans, 127, e2022JC018906 (2022)
7. Carlos Muñoz-Royo, T. Peacock, M. H. Alford, J. A. Smith, A. L. Boyer, C. S. Kulkarni, P. Lermusiaux, P. J. Haley, C. Mirabito, D. Wang, E. E. Adams, R. Ouillon, A. Breugem, B. Decrop, T. Lanckriet, R. Supekar, A. J. Rzeznik, A. Gartman, S. Ju, *Extent of impact of deep-sea nodule mining midwater plumes is influenced by sediment loading, turbulence and thresholds*, Commun. Earth Environ., 2(148), 2021
6. C. Rackauckas, Y. Ma, J. Martinsen, C. Warner, K. Zubov, R. Supekar, D. Skinner, A. Ramadhan & A. Edelman, *Universal differential equations for scientific machine learning*, arXiv:2001.04385 (preprint, 2020)
5. R. Supekar, V. Heinonen, K. Burns & J. Dunkel, *Linearly forced fluid flow on a rotating sphere*, J. Fluid Mech., 892 (A30), 2020
4. R. Supekar, D. Hewitt & N. Balmforth, *Translating and squirming cylinders in a viscoplastic fluid*, J. Fluid Mech., 882 (A11), 2020 (*featured as the* ***cover***)
3. R. Supekar & T. Peacock, *Interference and transmission of locally forced internal waves*, J. Fluid Mech., 866 (350-368), 2019
2. C. Kulkarni, P. Haley, P. Lermusiaux, A. Dutt, A. Gupta, C. Mirabito, D. Subramani, S. Jana, W. Ali, T. Peacock, C. Royo, A. Rzeznik, R. Supekar, *Real-time sediment plume modeling in the Southern California Bight*, Oceans 2018 MTS/IEEE Charleston
1. R. Supekar & M. V. Panchagnula, *Dynamics and stability of a fluid filled cylinder rolling on an inclined plane*, arXiv:1408.6654 (preprint, 2014)

Blogs, Media Articles & Panels

7. D. McMullan, citing R. Supekar's INMA blog in top 3 articles of 2023, *INMA's top stories from 2023*, December 2023
6. R. Supekar, *INMA Ideas blog on The NYT Smart Paywall*, November 2023

5. A. Bernard, INMA Smart Data Initiative Lead, covering a talk by R. Supekar, *3 themes emerge as media leaders share their data journey*, June, 2023
4. R. Supekar, *Mentoring session on research, academia, and machine learning*, Pydata NYC, November 2022
3. S. Goldman, covering interviews with R. Supekar and C. Wiggins, *VentureBeat: How machine learning helps The New York Times power its paywall*, August 2022
2. M. White, citing R. Supekar's work on the NYT paywall, *The New York Times dynamic paywall model, analyzed*, August 2022
1. R. Supekar, *How The New York Times uses machine learning to make its paywall smarter*, NYT Open Blog, August 2022

Selected Conference Presentations & Seminars

11. **[invited]** R. Supekar, *Machine learning for a smart paywall at The New York Times*, Smart Data Workshop, INMA World Congress of News Media, May, 2023
10. **[invited]** R. Supekar, *Causal machine learning for a smart paywall at The New York Times*, Managing Disruptive Technologies course, Heinz College at Carnegie Mellon University, April, 2023
9. R. Supekar, *Causal machine learning for a smart paywall at The New York Times*, PyData NYC, November 2022
8. **[invited]** R. Supekar, *Data science and algorithmic targeting at The New York Times*, Analytics seminar series, MIT Sloan School of Management, May 2022
7. R. Supekar, B. Song, A. Hastewell, A. Mietke & J. Dunkel, *Learning active hydrodynamics from particle simulations and experiments*, APS March Meeting (Virtual), March 2021
6. R. Supekar, V. Heinonen, K. J. Burns & J. Dunkel, *Linearly forced fluid flow on a rotating sphere*, APS Division of Fluid Dynamics Meeting (Virtual), November 2020
5. R. Supekar, V. Heinonen, K. J. Burns & J. Dunkel, *Linearly driven flow on a rotating sphere*, Universality: Turbulence across vast scales meeting, Flatiron Institute, New York, December 2019
4. R. Supekar & T. Peacock, *Interference of locally forced internal waves in non-uniform stratifications*, APS Division of Fluid Dynamics Meeting, Denver, USA, November 2017
3. R. Supekar, R. Musgrave, E. C. Fine, M. Alford, J. MacKinnon, & T. Peacock, Observations of regional inhomogeneity of double-diffusive layering in the Arctic ocean, *6th Forum on Arctic Modeling and Synthesis (FAMOS) Meeting, Woods Hole, USA, October 2017 [poster]*,
2. R. Supekar & T. Peacock, *Transmission of internal waves generated by a localized surface forcing*, 8th International Symposium on Stratified Flows, San Diego, USA, September 2016
1. R. Supekar & M. V. Panchagnula, *Stability of a rolling fluid filled cylinder*, APS Division of Fluid Dynamics Meeting, San Francisco, USA, November 2014

Teaching Experience

Teaching Assistant, MIT 09/2017 – 05/2020

- Led and assisted teams for designing weekly problem sets, quizzes and final exams. Conducted recitations and review lectures to meet the learning objectives for undergraduate and graduate courses with 60 - 120 students.

Course	Semester	Student Rating
2.25 Advanced Fluid Mechanics	Fall 2017	6.4/7
2.003 Dynamics and Controls	Fall 2018	6.3/7
	Spring 2019	6.4/7
	Fall 2019	6.4/7
	Spring 2020	NA

Kauffman Teaching Certificate Program, MIT 05/2019 – 06/2019

- Completed 8 practice-based workshops, in which participants learn evidence-based teaching techniques

Teaching Assistant, NPTEL IIT Madras 01/2015 – 03/2015

- Prepared online teaching material, problem sets and exams for an all-India MOOC on "Engineering Mechanics" with over 6,000 enrolled students

Professional Service

- Reviewed a total of 9 articles in journals such as Journal of Machine Learning Research, Physical Review Fluids, Journal of Fluid Mechanics, Physical Review Research, Physical Review E

PhD Research

Physics-informed machine learning | Learning equations from biological data 01/2019 – 07/2021

- Developed a robust learning framework to infer interpretable continuum equations from particle data while incorporating the relevant physics and symmetries in the system
- Successfully applied the algorithm to learn hydrodynamic equations from microscopic simulation data of a chiral active particle model mimicking swimming cells and from microroller experiments
- Modeled reaction-diffusion systems by combining Partial Differential Equations with Neural Networks

Active turbulence forced by linear instabilities 09/2018 – 01/2020

- Extended a novel method for forcing turbulence that enables data-driven phenomenological modeling of pattern-forming systems on rotating spheres, such as planetary atmospheres
- Derived analytical solutions and performed numerical simulations using the Python package Dedalus to validate model behaviour

Motion of active and passive cylinders in viscoplastic fluids 06/2018 – 09/2019

- Derived exact analytical nonlinear solutions and compared them with numerical simulations of Bingham fluid flow around smooth and partially rough cylinders
- Developed a model for squirmers by prescribing cylinder surface velocity to understand the swimming behaviour of micro-organisms in viscoplastic fluids

Leadership Experience

Events Officer, MIT SIAM Chapter 12/2018 – 12/2020

- Organized monthly seminars by professors and graduate students across various departments
- Planned events to promote collaboration in Applied Mathematics and Computation within and beyond MIT

Vice President, MIT Tang Hall Student Government 09/2017 – 09/2018

- Organized monthly strategy meetings and oversaw the operations affecting over 300 graduate students
- Advocated and provided input to the MIT Administration for renovations in the Tang hall building

Orientation Chair, MIT Graduate Association of Mechanical Engineers 04/2017 – 10/2017

- Planned events for incoming graduate students to expose them to the departmental social life and academics
- Managed a mentorship program to connect incoming students with mentors based on professional interests

President, MIT Sangam 04/2016 – 04/2017

- Planned and organized monthly social events as a part of the largest Indian cultural organization at MIT
- Conducted a three-day orientation program for incoming MIT students in Delhi, India
- Led a team of 40 officers and volunteers to organize the annual Indian cultural show that brings over 300 attendees from the Greater Boston Area

Hobbies

- Alpine Skiing • Hiking
- Long-distance running | current personal records: marathon (3:17:51), half marathon (1:34:13), 5k (19:01)