Robin Yadav

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Education

University of British Columbia, BSc, Math & Computer Science (Combined Hons.)   Sept. 2021 – May 2026

- **GPA**: 91.6 % (3.9 / 4.0)
- **Selected Courses (* graduate):** Advanced Machine Learning*, Measure Theory*, Theory of Computing*, Real Analysis, Data Structures and Algorithms, Linear Algebra, Introduction to Probability

Preprints and Publications

[Oral] **R. Yadav**, S. Xie, T. Wang, Z. Li, "Provable Benefit of Sign Descent: A Minimal Model Under Heavy-Tail Class Imbalance", *NeurIPS OPT Workshop*, 2025.

R. Yadav, Q. Yan, G. Wolf, J. Bose, R. Liao, "RetroSynFlow: Flow Matching for Accurate and Diverse Single-Step Retrosynthesis", *NeurIPS*, 2025. [arxiv]

P. Richtárik, S. M. Giancola, D. Lubczyk, **R. Yadav**, "Local Curvature Descent: Squeezing More Curvature out of Standard and Polyak Gradient Descent", *NeurIPS*, 2025. [arxiv]

[Spotlight] F. Kunstner, A. Milligan, **R. Yadav**, M. Schmidt, A. Bietti, "Heavy-Tailed Class Imbalance and Why Adam Outperforms Gradient Descent on Language Models", *NeurIPS*, 2024. [arxiv]

Research Experience

Visiting Student Researcher, Toyota Technological Institute at Chicago   May 2025 – Sept. 2025
Supervisor: Dr. Zhiyuan Li   Chicago, IL

- Conducted a comprehensive literature review on the convergence theory of modern adaptive optimization algorithms with structured preconditioners such as Adam, AdaGrad, and Shampoo
- Assisted in developing a minimal language modelling setup with heavy-tailed class imbalance and proved the theoretical benefits of adaptive coordinate-wise algorithms, e.g., sign descent over gradient descent (GD)
- Trained and evaluated simple language modelling setups, e.g., simple transformers, linear bigram models using PyTorch to compare non-Euclidean steepest methods and adaptive algorithms such as Adam to standard GD

Undergraduate Researcher, UBC Deep Structured Learning Lab   May 2024 – May 2025
Supervisor: Dr. Renjie Liao   Vancouver, BC

- Proposed a discrete flow matching framework for retrosynthesis, which maps product molecules to reactant molecules by leveraging synthons and uses Feynman-Kac steering to improve diversity, beating SOTA by 19%
- Engineered a Python library to train and evaluate SOTA discrete flow matching models with inference-time steering for graph translation tasks on a compute cluster
- Authored a first-author manuscript for a top ML conference following an extensive literature review and successfully led the reviewer rebuttal, resulting in score increases

Visiting Student Researcher, KAUST Optimization and Machine Learning Lab   Jan. 2024 – May 2024
Supervisor: Dr. Peter Richtárik   Jeddah, SA

- Established convergence guarantees for new adaptive preconditioned optimizers in non-stochastic convex optimization, which exploit a novel notion of local curvature information to improve performance
- Proved properties of convex functions with local curvature and formulated experimental settings satisfying theoretical assumptions, demonstrating 25% faster convergence speed compared to standard methods

Undergraduate Researcher, UBC Optimization and Machine Learning Lab   May. 2023 – Dec. 2023
Supervisor: Dr. Mark Schmidt   Vancouver, BC

- Developed a Python library with PyTorch, NumPy, and Pandas to run and visualize 15k+ experiments on transformer models, vision CNNs, and linear classifiers, testing the performance of modern optimizers
- Devised small-scale ML experiments that replicate the performance disparity between Adam and SGD optimizers on LLM training, enabling 100× faster experiment runtime and better understanding of optimization algorithms

Undergraduate Researcher, UBC Computer Vision Lab
Supervisor: Dr. Leonid Sigal

May. 2022 – Sept. 2022
Vancouver, BC

- Developed HoloLens AR headset app using Unity and C#, which enables users to build large object detection datasets through annotation of objects in their surroundings
- Implemented and trained SOTA object detection transformer models using PyTorch and OpenCV on a weakly labeled dataset, obtaining a mean Average Precision of 33%

Work Experience

Teaching Assistant
UBC Computer Science

Sept. 2025 –
Vancouver, BC

- Led weekly lab sessions and office hours for CPSC 210 (Software Construction), teaching software concepts to 20+ students and providing hands-on guidance with programming

ML Software Engineer Intern
Royal Bank of Canada Borealis AI

Sept. 2023 – Dec. 2023
Vancouver, BC

- Developed a production-ready ML model prediction pipeline in Python for bill payment reversal, leveraging Kubernetes and Jenkins for deployment and CI/CD
- Implemented a new partitioning scheme for SQL database, which reduced query latency by up to 70%

Awards and Scholarships

Undergraduate Student Research Award, NSERC ×3 ($6000 CAD/per award) 2022 – 2024

Research Abroad Award, UBC Go Global ($1000 CAD) 2025

Rick Sample Memorial Award, UBC Computer Science ($1300 CAD) 2024
- Nominated by the Department of Computer Science for outstanding students involved in CS research

Y.P. Heung Award Foundation Award in Science, UBC Science ($5000 CAD) 2022
- For undergraduate students with outstanding academic achievement and community involvement

Stanley M. Grant Scholarship, Mathematics Department ($1500 CAD) 2022
- Nominated by the Mathematics Department for outstanding students in mathematics

Trek Excellence Scholarship, UBC ($1500 CAD) 2022
- Awarded to the top 5% of students in the Faculty of Science

Fred J. Muir Award in Science, UBC Science ($170 CAD) 2022

Schulich Leader Scholarship, UBC **($80,000 CAD)** 2021
- Canada's largest undergraduate STEM scholarship

Bronze Medal, Canada Wide Science Fair 2021

Projects

Applied AI - UBC Agrobot Engineering Design Team
- Collaborated with a team of 10+ people to create a fully autonomous precision farming robot to reduce the impacts of farming on the environment
- Utilized OpenCV and Python to apply image filtering and segmentation techniques to pre-process and clean a leaf image dataset, additionally synthesizing new images, resulting in a dataset of 20,000 examples
- Built scripts with TensorFlow to train and conduct hyperparameter searches on several CNN image classification models to classify leaf plant health; consistently exceeded a 90 % accuracy on test data with ResNet

Wildfire Drone Automation with Reinforcement Learning ⌁
- *Awards: Canada Wide Science Fair Bronze Medal, BC South Fraser Regional Science Fair Gold Medal*
- Engineered a 3D fire environment in Unreal Engine with C++ to collect simulated forest fire images; used data to train imitation learning models with PyTorch, resulting in 25% decrease in RL model training time

- Implemented Deep RL algorithms (Q-Learning and PPO) with Python and PyTorch to train a virtual drone agent to fly along a fire front in a simulation; achieved a 116% mean reward increase over a random policy

Deep Learning Based Aerial Wildfire Detection ⬈

- *Awards: Youth Science Canada STEM Fair Award (5/500 projects), BC Youth Innovation Showcase Finalist*
- Assembled and preprocessed a dataset of 5000+ images for training CNN-based object detection models to detect fire; ran hyperparameter search and data augmentation experiments to improve model performance
- Attained a fire detection model with 89.9% mAP, used Python and OpenCV to deploy the model on a Raspberry Pi to conduct real-time (10 FPS) inference on a drone video feed accessible to users via a Python Flask web app

Technical Skills

Languages: Python, Java, C++, C#, Matlab, Julia, C, SQL

Tools/Libraries: PyTorch, TensorFlow, NumPy, Scipy, Pandas, Matplotlib, OpenCV, Bash, Jupyter, Git, Linux