RUBY SHRESTHA

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RESEARCH INTERESTS

Reliable Deep Generative Modeling; Data Augmentation; Causal Modeling and Reasoning; Interventional and Counterfactual Generation; Robustness to Spurious Correlations and Distribution Shift; Trustworthy ML

EDUCATION

PhD in Computing and Information Sciences *Aug 2022 – Present*
Rochester Institute of Technology (RIT) *Rochester, NY, USA*
Expected graduation: May 2027
Advisor: Prof. Linwei Wang | Research group: Computational Biomedicine Lab
Relevant coursework: Deep Learning, Statistical Machine Learning, Non-convex Optimization, Quantitative Foundations, Data Science & Analytics, Visual Analytics

B.Sc. in Computer Science and Information Technology *Oct 2013 – Apr 2018*
Tribhuvan University *Nepal*

RESEARCH EXPERIENCE

Computational Biomedicine Lab, RIT Rochester, NY, USA
Graduate Research Assistant *Aug 2022 – Present*

Robustness analysis of generative models under feature correlation *(first author, accepted at TMLR 2026)*

- *Led a large-scale study of 13+ generative models and mitigation strategies* from explainable AI, causal modeling, and data augmentation, assessing how well they generalize to minority images across synthetic, natural, and medical datasets under increasing feature correlations.
- *Built new benchmark dataset (Co-occurrence MNIST) and multi-metric evaluation framework*, identifying root causes of failure: covariate shift, low minority sample diversity, mismatched inductive bias, and biased classifier supervision.
- *Developed a theoretical perspective on observed failures* by drawing an analogy between minority image generation and potential outcome estimation in causal inference.

Robust deep generative framework, ProReGen *(first author, ICLR 2026)*

- *Developed a model-agnostic generative framework* that combines input orthogonalization inspired by Robinson's partialling-out method in causal inference with progressive residual learning to generate underrepresented attribute combinations.
- *Improved minority generation accuracy over baselines* across diffusion models, VAEs, and GANs.

Counterfactual Image Generation *(work in progress)*

- *Developing a robust causal generative model* for counterfactual image generation that remains reliable under varying strengths of causal relationships between attributes.

Subgroup underrepresentation in medical image classification *(co-first author, FAIMI @ MICCAI 2023)*

- *Diagnosed failure modes and strengthened debiasing method* (distributionally robust optimization, invariant representation learning) for spurious correlations caused by subgroup underrepresentation in medical image classification.

Scientific ML for noisy real-world signals *(manuscript under review; RIT and Argentine Institute of Radioastronomy collaboration)*

- *Developed an unsupervised ML pipeline* combining Isolation Forest outlier rejection, β-VAE denoising, and Self-Organizing Map clustering to analyze approximately one million noisy radio-telescope pulses.
- *Introduced a peak-dominance score* to select pulses with distinct peaks, doubling the signal-to-noise ratio for a faint millisecond pulsar; *linked pulse clusters to pulsar emission physics*, suggesting a potential $\sim$3.5$\times$ improvement in timing precision for a pulsar used in pulsar timing arrays.

PUBLICATIONS

- **R. Shrestha**, A. Gopi, C. Meisenzahl, B. Lekhak, and L. Wang. "ProReGen: Progressive Residual Generation under Attribute Correlations." **ICLR**, 2026.

- C. O. Lousto, **R. Shrestha**, E. Zubieta, S. B. Araujo Furlan, G. Gancio, F. García, S. del Palacio, R. Missel, and L. Wang. "Single-pulse reanalysis of the 2024 Vela glitch and new observations of PSR J0437–4715 and PSR J1644–4559." arXiv:2609.03056 (preprint), 2026.
- M. Toloubidokhti, Y. Ye, R. Missel, X. Jiang, N. Kumar, **R. Shrestha**, and L. Wang. "DATS: Difficulty-Aware Task Sampler for Meta-Learning Physics-Informed Neural Networks." **ICLR**, 2024.
- N. Kumar*, **R. Shrestha***, Z. Li, and L. Wang. "Distributionally Robust Optimization and Invariant Representation Learning for Addressing Subgroup Underrepresentation: Mechanisms and Limitations." **FAIMI @ MICCAI**, 2023. (*Equal contribution.)
- **R. Shrestha**. "Maze Solving with Anomaly Tolerant Dead End Filling and A*: Implementation and Analysis." **Deerwalk Journal of Computer Science and Information Technology**, 2019.

INDUSTRY EXPERIENCE

Saugal Trading Company Pvt. Ltd. Nepal
Software Consultant *Apr 2021 – Jul 2022*

Deerwalk Inc. (now Cedar Gate Technologies) Nepal
Software Engineer / Team Lead / Development Manager *Sep 2015 – Mar 2021*
Progression: Software Engineering Intern (Sep 2015 – Apr 2018); Software Engineer (May 2018 – Mar 2019); Software Engineer & Team Lead (Apr 2019 – Jan 2021); Senior Software Engineer & Development Manager (Jan – Mar 2021).

- Led healthcare analytics projects involving Elasticsearch query optimization and development of data extraction frameworks for descriptive, predictive, and trend-based reporting and visualization.

SKILLS

Generative & Trustworthy ML	Diffusion models, VAEs, GANs, data augmentation (few-shot adaptation, CycleGAN, swapping autoencoder); explainable AI, invariant representation learning, distribution shift, spurious correlations, subgroup underrepresentation
Causal ML	Structural causal models, potential outcome framework, confounding, interventions, counterfactual generation
ML Stack	Python, PyTorch, scikit-learn, NumPy, Pandas, Weights & Biases, MLflow, MATLAB
Tools & Platforms	Linux, SLURM, Git, SQL, Elasticsearch, LaTeX

HONORS AND AWARDS

Dr. Russell & Melissa Bessette Award for Doctoral Student Excellence, RIT *2023*

National Female Education Award, Government of Nepal *2019*

Winner, International Girls in ICT Day Hackathon *2016*

Outstanding Cambridge Learners Award – Top in Country *2013*

CONFERENCE PRESENTATIONS

Poster: ProReGen: Progressive Residual Generation under Attribute Correlations, ICLR *Apr 2026*

Oral: Maze Solving with Anomaly Tolerant Dead End Filling and A*, IT4D *Aug 2018*

TEACHING EXPERIENCE

Guest Lecturer, CISC-865 Deep Learning (PhD-level course), RIT *Nov 2025*

Guest lecture on robustness of deep learning models to observed attribute correlations.

Workshop Instructor, Deerwalk Institute of Technology *Jan – Mar 2019*

Taught data management and analysis with Elasticsearch.

Guest Trainer, Local Development Training Academy *Jul 2018*

Delivered hands-on training on cloud services, content management, and project management tools.