RISHAB BALASUBRAMANIAN

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About Me

I'm currently a first year Computer Science PhD student at Virginia Tech, advised by Dr. Tu Vu. My interests lie at the intersection of multimodal deep learning, efficiency and alignment. This includes data selection for pre-training, grounded representation learning, mechanistic interpretability, sparsity, model merging and distillation, and better model architectures.

Programming Languages and Frameworks

Programming Languages: C, C++, Python, LaTeX, Shell Programming
Frameworks: ROS, Gazebo, OpenCV, Keras, PyTorch, PyTorch3D, HuggingFace

Education

- **Virginia Tech** — Blacksburg, VA
  *Ph.D in Computer Science (Advisor: **Tu Vu**)* — *Aug 2024 - June 2029 (Expected)*
- **Oregon State University** — Corvallis, OR
  *M.S in Computer Science & Artificial Intelligence (Advisor: **Huazheng Wang**)* — *Sep 2021 - May 2024*
- **National Institute of Technology** — India
  B.Tech in Instrumentation And Control Engineering — *Aug 2016 - May 2020*

Publications And Preprints

- **Rishab Balasubramanian**, Jiawei Li, Prasad Tadepalli, Huazheng Wang, Qingyun Wu, and Haoyu Zhao. Adversarial attacks on combinatorial multi-armed bandits. In *Forty-first International Conference on Machine Learning*, 2024 **paper**
- Zichen Wang, **Rishab Balasubramanian**, Hui Yuan, Chenyu Song, Mengdi Wang, and Huazheng Wang. Adversarial attacks on online learning to rank with stochastic click models. *Transactions on Machine Learning Research*, 2024 **paper**
- Zeyu Zhang, Yi Su, Hui Yuan, Yiran Wu, **Balasubramanian, Rishab**, Qingyun Wu, Huazheng Wang, and Mengdi Wang. Unified off-policy learning to rank: a reinforcement learning perspective. *Advances in Neural Information Processing Systems*, 36, 2024 **paper**
- **Balasubramanian, Rishab** and Kunal Rathore. Contrastive learning for object detection. *arXiv preprint arXiv:2208.06412*, 2022 **paper**
- **Balasubramanian, Rishab**, Lifeng Zhou, Pratap Tokekar, and PB Sujit. Risk-aware submodular optimization for stochastic travelling salesperson problem. In *2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 4720–4725. IEEE, 2021 **paper**
- **Balasubramanian, Rishab** and Sujit PB. A cooperative framework for autonomous landings of quadrotors using vision on a moving ugv. In *AIAA Scitech 2021 Forum*, page 1880, 2021 **paper**

Research Experience

- **Efficient Data Mixing for Prompting an Fine-Tuning** — Virginia
  *Research with **Dr. Tu Vu** (VT)* — *September 2024 - Present*
  - Currently exploring data selection for multi-task prompting/fine-tuning.
  - Developing methods to select better examples from different tasks to improve downstream performance

- **Adversarial Attacks on Multi-Armed Bandits** Oregon
  *Research with **Dr. Huazheng Wang** (OSU)* *September 2022 - Present*
  - Led the work to design a novel adversarial attack algorithm on combinatorial multi-armed bandits (CMAB)
  - Showed the theoretical difficulty in attacking CMAB environments in white-box and black-box settings, and provided the first ever algorithm to attack CMAB instances with sublinear cost.
  - Provided experimental results to substantiate claims of successful attacks on recommendation and other graph based tasks.
  - Simultaneously proved that online learning to rank can be formulated as an offline reinforcement learning problem.
  - Our results have been accepted to Neurips 23, ICLR 24 and TMLR 24.

- **Block-wise Trainable Neural Networks (code)** Remote
  *Research with **Dr. Beidi Chen** (Meta)* *August 2022 - December 2022*
  - Developed a method to train neural network architectures sequentially to reduce training time, memory consumption and FLOPs.
  - Enforced gradient blocking and data pruning methods to further improve efficiency, reducing training time by approx. 30% while limiting drop in test accuracy to $< 2\%$.
  - Tested on a variety of networks including Transformers, ResNets and VGG models

- **User-Controlled Contrastive Learning for OOD Detection (code)** Oregon
  *Course project with **Prof. Stefan Lee** (OSU)* *March 2022 - June 2022*
  - Following similar works on boosting contrastive learning using ranked positives, we proposed a novel method to enforce ranking which leverages user expertise.
  - By incorporating user-defined ranked positives into contrastive learning framework, we observed an improvement in performance (accuracy and mAP scores) of certain tasks such as object detection and classification, while reduction in other tasks such as OOD detection.
  - We further perform a study of the results and provide explanations into what might be negatively impacting certain tasks.

- **3D Reconstruction from Endoscopy Images** India
  *Research Scientist at **EndovisionAI*** *January 2021 - April 2021*
  - Trained an encoder-decoder model using transformation consistency losses for unsupervised depth estimation from RGB endoscopy images.
  - Created an API for visualizing 3D pointclouds from the output depthmap.

- **Risk Averse Travelling Salesman Problem (code)** India
  *Research with **Dr. Sujit** (IISER Bhopal) and **Dr. Tokekar** (University of Maryland)* *June 2020 - November 2020*
  - Developed a risk aware greedy algorithm to maximize the Conditional Value at Risk (CVaR) using a submodular function.
  - We further prove that the algorithm has polynomial runtime lower than current SOTA and approximation factor which is proportional to the optimal solution.
  - Finally, we also show that the suboptimality gap of the solutions is bound by a constant factor.

Teaching Experience

- Mentor for freshmen in the last two years of undergraduate
- TA for ENGR 201: Electrical Fundamentals I at Oregon State with Dr. Pallavi Dhagat (Fall 2021)
- TA for CS 325: Analysis of Algorithms at Oregon State with Prof. Umma Reddy (Winter 2022)
- Created teaching material for CS 514: Algorithms at Oregon State with Prof. Samina Ehsan (Spring 2022)
- TA for AI 534: Machine Learning at Oregon State with Dr. Xiaoli Fern (Fall 2023)
- TA for CS 5814: Machine Learning at Virginia Tech with Dr. Chandan Reddy (Fall 2024)