

Divyat Mahajan

First Year Ph.D. Student
Université de Montréal, MILA
Advisor: [Prof. Ioannis Mitliagkas](#)

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EDUCATION

Université de Montréal
Ph.D. in Computer Science
Advisor: [Prof. Ioannis Mitliagkas](#)

September '22 - July '26 (Expected)

Université de Montréal
M.Sc. in Computer Science (Research), Specialization: Artificial Intelligence
Advisor: [Prof. Ioannis Mitliagkas](#)

September '21 - July '22
GPA: 4.3/4.3

Indian Institute of Technology Kanpur
B.S. in Mathematics and Scientific Computing
B.Tech in Computer Science and Engineering (Double Major)

July '14 - June '19
GPA: 8.6/10

RESEARCH INTERESTS

Primary: Causal Representation Learning, Out-of-Distribution Generalization & Robustness in Machine Learning
Others: Causal Inference, Probabilistic Models, Explainable Machine Learning

WORK EXPERIENCE

• MILA Quebec AI Institute - Graduate Research Assistant
Advisor: [Prof. Ioannis Mitliagkas](#)

September '21 - Present

Projects: Causal Inference, Identifiability in Neural Networks, Out-of-Distribution Generalization

• Microsoft Research India - Research Fellow
Advisor: [Dr. Amit Sharma](#)

July '19 - July '21

Projects: Causal Inference, Counterfactual Explanations, Domain Generalization, Privacy Attacks in ML

• Aalto University - Research Intern
Advisor: [Prof. Samuel Kaski](#)

May '18 - July '18

Projects: Approximate Bayesian Computation for Cancer Simulation

• National University of Singapore - Research Intern
Advisor: [Prof. Wynne Hsu](#) and [Prof. Lee Mong Li](#)

May '17 - July '17

Projects: Recommender Systems for Side Effect Prediction

PUBLICATIONS (*: EQUAL CONTRIBUTION)

Conference Publications

• Domain Generalization using Causal Matching

[\[Link\]](#)

[Divyat Mahajan](#), Shruti Tople, Amit Sharma

Proceedings of the International Conference on Machine Learning (ICML '21) (Long Talk)

• Towards efficient representation identification in supervised learning

[\[Link\]](#)

Kartik Ahuja*, [Divyat Mahajan*](#), Vasilis Syrgkanis, Ioannis Mitliagkas

Proceedings of the Conference on Causal Learning and Reasoning (CLeaR '22)

• Split-Treatment Analysis to Rank Heterogeneous Causal Effects for Prospective Interventions

[\[Link\]](#)

Yanbo Xu, [Divyat Mahajan](#), Liz Manrao, Amit Sharma, Emre Kiciman

Proceedings of the ACM International Conference on Web Search and Data Mining (WSDM '21) (Oral)

• Towards Unifying Feature Attribution and Counterfactual Explanations: Different Means to Same End [\[Link\]](#)

Ramaravind Mothilal, [Divyat Mahajan](#), Chenhao Tan, Amit Sharma

Proceedings of the AAAI/ACM Conference on AI, Ethics, and Society (AIES '21)

• A Generative Framework for Zero-Shot Learning with Adversarial Domain Adaptation

[\[Link\]](#)

Varun Khare*, [Divyat Mahajan*](#), Homanga Bharadhwaj, Vinay Verma, Piyush Rai

Proceedings of the IEEE Winter Conference on Applications of Computer Vision (WACV '20)

Workshop Publications

- **Interventional Causal Representation Learning** [\[Link\]](#)
Kartik Ahuja, Yixin Wang, [Divyat Mahajan](#), Yoshua Bengio
Workshop on Neuro Causal and Symbolic AI (NeurIPS '22) (Oral)
- **Preserving Causal Constraints in Counterfactual Explanations for Machine Learning Classifiers** [\[Link\]](#)
[Divyat Mahajan](#), Chenhao Tan, Amit Sharma
Workshop on Machine Learning and Causal Inference for improved decision making (NeurIPS '19) (Oral)
- **The Connection between Out-of-Distribution Generalization and Privacy of ML Models** [\[Link\]](#)
[Divyat Mahajan](#), Shruti Tople, Amit Sharma
Workshop on Privacy Preserving Machine Learning (NeurIPS '20)

Preprints

- **Empirical Analysis of Model Selection for Heterogeneous Causal Effect Estimation** [\[Link\]](#)
[Divyat Mahajan](#), Ioannis Mitliagkas, Brady Neal, Vasilis Syrgkanis
Under review at International Conference on Artificial Intelligence and Statistics (AISTATS '23)
- **Synergies Between Disentanglement and Sparsity: A Multi-Task Learning Perspective**
Sebastien Lachapelle*, Tristan Deleu*, [Divyat Mahajan](#), Ioannis Mitliagkas, Yoshua Bengio, Simon Lacoste-Julien, Quentin Bertrand
Under review at International Conference for Learning Representations (ICLR '23)

SOFTWARE

- **RobustDG - Microsoft** [\[Github\]](#) [\[Commit History\]](#)
Core developer for Microsoft's open-source framework for building robust ML models that generalize to unseen domains
- **DiCE - InterpretML** [\[Github\]](#) [\[Commit History\]](#)
Collaborating on the InterpretML's open-source framework to support feasible counterfactual explanation approaches

ACADEMIC SERVICE

- **Reviewer:** ICML 2022, NeurIPS 2021-2022, IEEE SMDS 2021, ML RC 2021, MAIS 2022
RAI@ICLR 2021, SCIS@ICML 2022, Algorithmic Recourse@ICML 2021
- **Sub Reviewer:** EMNLP 2021

TALKS

- **Latent Identification in Multi-Task Learning**
Microsoft Research India
CausalML Reading group, ServiceNow Research
- August '22*
November '22

AWARDS & ACHIEVEMENTS

- Received the **outstanding reviewer award** for ICML 2022
- Received the **outstanding reviewer award** for the ML Reproducibility Challenge 2021
- Publication selected for the **long talk** (top 3% submissions) at **ICML 2021**
- Received the **Academic Excellence Award, IIT Kanpur** for the academic session 2017-2018
- Received the **NeurIPS 2019 travel award** to attend the conference
- Received the **UdeM Accelerated Transition Scholarship** for transfer from masters to doctorate program
- Received the **UdeM Exemption Scholarship** for tuition fee reduction in both the masters and doctorate program

RESEARCH PROJECTS

Latent Identification in supervised multi-task learning

[\[Project\]](#)

Advisors: *Dr. Kartik Ahuja, Prof. Vasilis Syrgkanis, Prof. Ioannis Mitliagkas, MILA*

September '21 - September '22

- Proved novel identification result for multi-task supervised learning with independence constrained representations; where we require less amount of auxiliary information as compared to prior works.
- Proposed a practical approach that utilizes linear ICA for identification and evaluated it on regression and classification tasks.
- Accepted as part of the proceedings of the conference CleaR 2022, with the extension for analyzing the benefits of identification for downstream tasks in submission at conference ICLR 2023

Domain Generalization with Causal Matching & Privacy Attacks

[\[Project\]](#)

Advisors: *Dr. Amit Sharma, Dr. Shruti Tople, Microsoft Research*

March '20 - September '21

- Proposed a causal framework for the problem of domain generalization (DG) and used it to prove the incorrectness of the prior DG methods via d-separation principles.
- Developed a novel algorithm (MatchDG) that uses contrastive learning to satisfy the invariance criteria from the causal graph and achieves the state-of-the-art out-of-domain accuracy on the Rotated-MNIST, Fashion-MNIST, PACS, Chest X-ray datasets.
- Established a connection between out-of-distribution generalization and privacy attacks, and used it to demonstrate issues with the state of the art DG algorithms under membership inference attacks.
- Work on MatchDG got accepted at the conference ICML 2021 for Long Talk, and the work on relationship with privacy attacks got accepted at the NeurIPS PPML Workshop 2020, along with the creation of the Microsoft's open source framework RobustDG.

Feasible Counterfactual Explanations for ML Classifiers

[\[Project\]](#)

Advisors: *Dr. Amit Sharma, Microsoft Research, Prof. Chenhao Tan, University of Colorado Boulder*

July '19 - July '20

- Proposed a causal proximity regularizer using structural causal models (SCM) to address the feasibility of counterfactual (CF) explanations for Machine Learning classifiers.
- Developed a generative framework using variational inference for efficient CF generation and feasibility preservation under different assumptions of the problem setting like access to SCM, User Feedback, etc.
- Accepted for oral spotlight presentation at the NeurIPS CausalML Workshop 2019, and integrated into the open source framework DiCE by InterpretML.

Ranking Causal Effects for Prospective Interventions

[\[Paper\]](#)

Advisors: *Dr. Amit Sharma, Dr. Emre Kiciman, Microsoft Research*

December '19 - October '20

- Worked on the sensitivity analysis of methods for heterogeneous causal effect estimation of novel treatments.
- Developed a technique to capture the sensitivity of a model by generating unobserved confounders and implemented it on a large real-world software dataset for model selection under the proposed split treatment framework.
- Accepted as part of the proceedings of the conference WSDM 2021 for oral presentation.

RELEVANT COURSEWORK (*: RECEIVED BEST GRADE)

Machine Learning	Machine Learning*, Representation Learning*, Computer Vision*
	Causal Inference*, Probabilistic Graphical Models*
	Theoretical Deep Learning*, Probabilistic Machine Learning*
Statistics	Probability and Statistics*, Applied Stochastic Process, Statistical Inference
Mathematics	Calculus*, Linear Algebra & Differential Equations*, Numerical Computation*
	Real Analysis, Complex Analysis, Abstract Algebra, Topology*
Algorithms & Theory	Data Structures and Algorithms, Advanced Algorithms, Quantum Computing

TECHNICAL SKILLS

Programming Languages	Python, C/C++, Bash
Software and Utilities	Git, Slurm, L ^A T _E X, PyTorch, Sklearn, ELFI, DoWhy