

Divyat Mahajan

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

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EDUCATION

- Université de Montréal** *September '21 - July '23 (Expected)*
M.Sc. in Computer Science (Research), Specialization: Artificial Intelligence GPA: 4.3/4.3
Advisor: [Prof. Ioannis Mitliagkas](#)
- Indian Institute of Technology Kanpur** *July '14 - June '19*
B.S. in Mathematics and Scientific Computing GPA: 8.6/10
B.Tech in Computer Science and Engineering (Double Major)

RESEARCH INTERESTS

- Primary:** Generalization, Robustness & Explainability in Machine Learning, Causal Inference
Others: Probabilistic Models, Bayesian Statistics, Algorithmic Fairness

RESEARCH EXPERIENCE

- MILA - Graduate Research Assistant** *September '21 - Present*
Advisor: [Prof. Ioannis Mitliagkas](#)
Projects: Causal Inference, Identifiability in Neural Networks, Out-of-Distribution Generalization
- Microsoft Research India - Research Fellow** *July '19 - July '21*
Advisor: [Dr. Amit Sharma](#)
Projects: Causal Inference, Counterfactual Explanations, Domain Generalization, Privacy Attacks in ML
- Aalto University - Research Intern** *May '18 - July '18*
Advisor: [Prof. Samuel Kaski](#)
Projects: Approximate Bayesian Computation for Cancer Simulation
- National University of Singapore - Research Intern** *May '17 - July '17*
Advisor: [Prof. Wynne Hsu](#) and [Prof. Lee Mong Li](#)
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 (*: Equal Contribution)
Proceedings of the IEEE Winter Conference on Applications of Computer Vision (WACV '20)

Workshop Publications

- Preserving Causal Constraints in Counterfactual Explanations for Machine Learning Classifiers** [Link]
[Divyat Mahajan](#), Chenhao Tan, Amit Sharma
Workshop on "Do the right thing": machine learning and causal inference for improved decision making (NeurIPS '19)

- **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)

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, IEEE SMDS 2021

- **Sub Reviewer:** EMNLP 2021
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AWARDS & ACHIEVEMENTS

- 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 Exemption Grant** for graduate tuition fee reduction

- Received Certificate of Achievement for Rank 33 in **ACM ICPC 2017** Asia Gwalior Online Programming Round

- Secured All India Rank 1940 in **JEE-Advanced 2014** out of 150,000 students with **percentile 98.71**
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RELEVANT COURSEWORK (*: RECEIVED BEST GRADE)

Machine Learning	Machine Learning Techniques* , Representation Learning* , Computer Vision* Probabilistic Machine Learning* , Probabilistic Graphical Models*
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, Docker, L^AT_EX, PyTorch, TensorFlow, Sklearn, ELFI, DoWhy

EXTRACURRICULAR ACTIVITIES

- (2020) Managed the **Machine Learning Reading Group** at Microsoft Research India

- (2018) **Project Mentor** for the course Machine Learning Techniques (CS771A) offered by Prof. Piyush Rai at IIT Kanpur

- (2018) Mentored 5 students for a project on Recommender Systems under Association of Computing Activities, IITK

- (2017) Managed a team of 5 members to publish newsletter Alpha under Statmatics, mathematics society of IITK

- (2016) Volunteered in Blood Connect, NGO working to provide a solution for the shortage of blood in India

- (2015) Worked in National Service Scheme at IIT Kanpur to provide better education to underprivileged children
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REFERENCES

- [Prof. Ioannis Mitliagkas](#), Assistant Professor, University of Montréal

- [Dr. Amit Sharma](#), Senior Researcher, Microsoft Research India

- [Dr. Shruti Tople](#), Senior Researcher, Microsoft Research Cambridge

RESEARCH PROJECTS

Domain Generalization with Causal Matching & Privacy Attacks

[Project]

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

March '20 - Present

- 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.

Generative Zero Shot Learning with Adversarial Domain Adaptation

[Project]

Advisors: *Prof. Piyush Rai, IIT Kanpur*

February '18 - November '18

- Addressed the issue of domain shift between the training and test classes in zero shot learning (ZSL) using adversarial domain adaptation.
- Developed a generative framework to efficiently estimate class data distributions and proposed a regularizer based on Cycle GAN that improves its robustness against domain shifts.
- Accepted at the proceedings of the conference WACV 2020, with results better than many state-of-the-art ZSL models on various benchmark datasets.