



Digital October 2022

October 21, 9:30 to 7:30

Campus MIL (University of Montreal)

With the support of





Digital October

October 21, 2022
 MIL Campus
 (Université de Montréal)



	Atrium	Room 1502.1	Room 3561
8:30/9:30 a.m.	Welcome and registration of the speakers (Atrium)		
9:30/10:00 a.m.		Introductory remarks by Yoshua Bengio and Marie-Josée Hébert	
10:00/10:30 a.m.		Student Flash Presentations	
10:30/11:00 a.m.	Networking break (Atrium)		
11:00/11:45 a.m.		Student Flash Presentations	
11:45 a.m. 1:00 p.m.	Lunch break and networking (Atrium)		
1:00/2:00 p.m.	Posters Session	Tomorrow's Algorithms	
2:00/2:15 p.m.	Healthy break (Atrium)		
2:15/3:15 p.m.		Health and Artificial Intelligence	Smart Cities and Societies
3:15/3:45 p.m.	Networking break (Atrium)		
3:45/4:45 p.m.		Tomorrow's Algorithms	From Earth to Planets
4:45/5:00 p.m.	Healthy break (Atrium)		
5:00/6:00 p.m.		Health and Artificial Intelligence	From Earth to Planets / Smart Cities and Societies
6:00/6:30 p.m.	Awards ceremony		
6:30/7:30 p.m.	Networking mocktail		

[Detailed schedule of the day »](#)



Detailed schedule of the day and list of conferences

Veillez noter que les descriptions suivantes ont été conservées dans la langue originale dans laquelle sera donnée la conférence associée. / Please note that the following descriptions have been kept in the original language in which the associated lecture will be given.

Summary

- 8:30 – 9:30:** [Welcome](#) (Atrium)
- 9:30 – 10:00:** [Introductory remarks](#) (Room 1502.1)
- 10:00 – 10:30:** [Student Flash Presentations](#) (Room 1502.1)
- 10:30 – 11:00:** [Networking Break](#) (Atrium)
- 11:00 – 11:45:** [Student Flash Presentations](#) (Room 1502.1)
- 11:45 – 1:00:** [Lunch Break and Networking](#) (Atrium)
- 1:00 – 2:00:** [Posters Session](#) (Atrium)
- 1:00 – 2:00:** [Tomorrow's Algorithms](#) (Room 1502.1)
- 2:00 – 2:15:** [Healthy Break](#) (Atrium)
- 2:15 – 3:15:** [Health and Artificial Intelligence](#) (Room 1502.1)
- 2:15 – 3:15:** [Smart Cities and Societies](#) (Room 3561)
- 3:15 – 3:45:** [Networking Break](#) (Atrium)
- 3:45 – 4:45:** [Tomorrow's Algorithms](#) (Room 1502.1)
- 3:45 – 4:45:** [From Earth to Planets](#) (Salle 3561)
- 4:45 – 5:00:** [Healthy Break](#) (Atrium)
- 5:00 – 6:00:** [Health and Artificial Intelligence](#) (Room 1502.1)
- 5:00 – 6:00:** [From Earth to Planets / Smart Cities and Societies](#) (Salle 3561)
- 6:00 – 6:30:** [Awards Ceremony](#) (Atrium)
- 6:30 – 7:30:** [Networking Mocktail](#) (Atrium)

8:30 – 9:30: Atrium
Welcome

Welcome of participants and registration of presenters. Free coffee and pastries available.



9:30 – 10:00: Room 1502.1
Introductory remarks

Introductory remarks by Yoshua Bengio, Scientific Director of IVADO, followed by Marie-Josée Hébert, Vice-Rector for Research, Discovery, Creation and Innovation at the Université de Montréal.

10:00 – 10:30: Room 1502.1
Student Flash Presentations

Nicolas Cabrera Malik - PhD student, Operations and Logistics Management (HEC Montréal), under the supervision of Jorge E. Mendoza and Jean-François Cordeau
Title of the presentation: *An exact method for the park-and-loop routing problem*

Camille Rondeau Saint-Jean - MSc student, Biological Sciences (Université de Montréal), under the supervision of Timothée Poisot
Title of the presentation: *Un réseau neuronal profond pour la reconnaissance individuelle d'oiseaux d'après leurs chants*

Xiao Xia Liang - PhD student, Eau Terre Environnement (INRS), under the supervision of Erwan Gloaguen
Title of the presentation: *Auto-Detection Of Invalid Soil Spectra*

Arthur Chatton - Postdoctoral fellow, Pharmacy (Université de Montréal), under the supervision of Mireille Schnitzer
Title of the presentation: *La dialyse à l'ère digitale: prédiction et adaptation en temps réel*

Beheshteh T. Rakhshan - PhD student, Computer Science and Operations Research (Université de Montréal), under the supervision of Guillaume Rabusseau
Title of the presentation: *Tensor Networks for Machine Learning*

Julien Pallage - Undergraduate student, Electrical Engineering (Polytechnique Montréal), under the supervision of Antoine Lesage-Landry
Title of the presentation: *Optimisation en temps-réel de réseaux électriques intelligents*



10:30 – 11:00: Atrium
Networking Break

11:00 – 11:45: Room 1502.1
Student Flash Presentations

Patricia Gauthrin - PhD student, Philosophy (Université de Montréal), under the supervision of Marc-Antoine Dilhac

Title of the presentation: *Les drones militaires peuvent-ils être vertueux?*

Myriam Sahraoui - PhD student, Psychology (Université de Montréal), under the supervision of Bruno Gauthier and Karim Jerbi

Title of the presentation: *Étude du profil exécutif de l'enfant en combinant EEG haute densité, EEG mobile et intelligence artificielle*

Laurence Lachapelle-Bégin - PhD student, Educational Technology (Laval University), under the supervision of Didier Paquelin

Title of the presentation: *L'autoformation professionnelle en intelligence numérique: quelles dynamiques entre les travailleur.euse.s et les organisations?*

Bhargob Deka - PhD student, Civil Engineering (Polytechnique Montréal), under the supervision of James-A. Goulet

Title of the presentation: *Real-Time Uncertainty Modeling for Large-Scale Structural Health Monitoring*

Bill Xue - Undergraduate student, Mechanical Engineering (Polytechnique Montréal), under the supervision of Julie Carreau

Title of the presentation: *Analyse de modèles climatiques avec les Variational Autoencoders*

Michael Mayerhofer - Undergraduate student, Engineering Physics (Polytechnique Montreal), under the supervision of Jean Provost

Title of the presentation: *Conception d'un réseau de neurones pour l'imagerie ultrasonore d'une sonde avec un relai ergodique*

Tian Yue Ding - Undergraduate student, Medicine (Université de Montréal), under the supervision of Elie Bou Assi

Title of the presentation: *Prédiction des jours de crises d'épilepsie à partir du sommeil mesuré par un chandail connecté*



Guillaume Gagné-Labelle - Undergraduate student, Physics (Université de Montréal), under the supervision of Xu Ji and Yoshua Bengio
Title of the presentation: *Généralisation en apprentissage semi-supervisé*

Sacha Morin - PhD student, Computer Science and Operations Research (Université de Montréal), under the supervision of Guy Wolf
Title of the presentation: *StepMix: A Python package for Stepwise Estimation of Generalized Mixture Models*

11:45 – 1:00: Atrium Lunch Break and Networking

Meet the presenters in the Atrium where a complimentary buffet dinner will be served. If you have any questions about dietary restrictions, please ask at the lunch counter.

1:00 – 2:00: Atrium Posters Session

1- Natasha Clarke - Postdoctoral fellow, CRIUGM (Université de Montréal), under the supervision of Pierre Bellec
Title of the presentation: Whole-brain resting-state functional connectivity as a biomarker of Alzheimer's disease

2- Anna-Gabriela Ramirez - Undergraduate student, Psychology (Université de Montréal), under the supervision of Anne Gallagher
Title of the presentation: Développement typique des réseaux cérébraux au repos chez le nourrisson: étude en connectivité fonctionnelle NIRS

3 - Chantal-Valerie Lee - Undergraduate student, Linguistics and Translation (Université de Montréal), under the supervision of Simone Falk
Title of the presentation: Rhythmic coordination of children who stutter and their different interlocutors

4 - Salim-Rayane Mohamedi - Undergraduate student, Psychoeducation (Université de Montréal), under the supervision of Lyse Turgeon
Title of the presentation: Le transfert de connaissance de programmes d'interventions: une recension des écrits

5 - Auriane Thilloz - Undergraduate student, Psychoeducation (Université de Montréal), under the supervision of Lyse Turgeon



Title of the presentation: Filling in the rainbow: a complete view of the Perseus cluster in the optical with SITELLE

6 - Rose Jutras - Undergraduate student, Psychoeducation (Université de Montréal), under the supervision of Lyse Turgeon

Title of the presentation: Individual differences in face recognition: revealing behaviourally-relevant representations from brain activation

7 - Ata Madanchi - MSc student, Physics (McGill), under the supervision of Lena Simine

Title of the presentation: A Physics-Informed Deep-Learning model to simulate 3-dimensional Amorphous Structures

8- AnQi Xu - Undergraduate student, Medicine (Université de Montréal), under the supervision of Élie Bou Assi

Title of the presentation: Diagnostic d'Épilepsie: Exploration des Biomarqueurs de Connectivité sur EEG Routine basé sur la théorie des graphes

9- Vanessa McNealis - PhD student, Epidemiology and Biostatistics (McGill), under the supervision of Erica Moodie and Nema Dean

Title of the presentation: Doubly robust estimation of causal effects in network-based observational studies

10- Claudéric DeRoy - MSc student, Psychology (Université de Montréal), under the supervision of Sébastien Héту

Title of the presentation: Évaluation d'outils de prétraitement de signal d'activité électrodermale utilisant l'apprentissage machine

11- Safia Safa-Tahar-Henni - PhD student, Bioinformatics (Université de Montréal), under the supervision of Brian Wilhelm

Title of the presentation:

Prediction of small molecules that promote cell conversion and reprogramming

12- Philippe Maisonneuve - MSc student, Power Engineering (Polytechnique Montreal), under the supervision of Antoine Lesage-Landry

Title of the presentation: Multi-Agent Reinforcement Learning for Fast-Timescale Demand Response

13- Nanda Harishankar Krishna - PhD student, Computer Science and Operational Research (Université de Montréal), under the supervision of Guillaume Lajoie

Title of the presentation: Uncovering the relationship between activation and parameter dynamics during learning



14 - Debora Moreira Grass - MSc student, Veterinary Medicine (Université de Montréal), under the supervision of Sheila Laverty
Title of the presentation: Quantification of equine bone resorption in-vitro implementing artificial intelligence

15 - Alexandre Adam - PhD student, Physics (Université de Montréal), under the supervision of Laurence Perreault-Levasseur
Title of the presentation: Posterior samples of source galaxies in strong gravitational lenses with score-based priors

16 - Hao-Ting Wang - Postdoctoral fellow, CRIUGM (Université de Montréal), under the supervision of Pierre Bellec
Title of the presentation: Maintainable implementation of re-executable fMRI denoise benchmark to track changes overtime

17 - Chengyuan Zhang - PhD student, Civil Engineering (McGill), under the supervision of Lijun Sun
Title of the presentation: Bayesian Calibration of Intelligent Driver Model

18 - Marie-Eve Picard - MSc student, Psychology (Université de Montréal), under the supervision of Pierre Rainville
Title of the presentation: Signature cérébrale de l'expression faciale de la douleur

19 - Oumayma Gharbi - MSc student, Neuroscience (Université de Montréal), under the supervision of Elie Bou Assi
Titre de la présentation: Data mining resting-state EEG for the screening of major depressive disorder

20 - Dènahin H TOFFA - Postdoctorate, NeuroSciences (University of Montréal), under the supervision of Dang Khoa Nguyen
Title of the presentation: Classification multimodale de l'électroencéphalographie de routine pour le diagnostic de l'épilepsie

1:00 – 2:00: Room 1502.1
Tomorrow's Algorithms

Raphael Zerbato - PhD Student, Economics (HEC), under the supervision of Georges Dionne
Title of the presentation: Optimal Audit with Scoring: an extension to machine learning models



Auto-insurance fraud has been an important application of the contract theory literature in economics for few decades. In this study, we adapted the optimal audit model by Dionne et al. (2009) to a classification algorithm from the data-science literature. We compare the machine-learning expert system performances to the original design and analyze the out-put “red-flags”. The optimal audit model aims to reduce the expected cost of fraud through an optimal audit strategy. In the data-science literature, a cost sensitive algorithm minimizes the total expected cost of fraud. The optimal audit model goes further by linking the aggressiveness of the audit policy to the fraud rate itself.

Esmail Ghorbani – Postdoctoral Fellow, Mechanical Engineering (University of Montreal), under the supervision of Frederick Gosselin
Title of the presentation: Digital Twin for Damage Identification of Mechanical Systems Based on Physics-Informed Bayesian Inference

Any damage identification process has three steps: damage detection, damage localization and damage quantification. In this presentation, we will demonstrate the process of physics-informed Bayesian inference for damage identification of mechanical systems. The presentation will focus on mathematical concepts and how to employ the physics of the systems in the identification process. The difference between data-driven and the physics-informed result will be shown too.

Steven Dahdah - PhD student, Mechanical Engineering (McGill), under the supervision of James Richard Forbes
Title: Data-Driven Modeling and Control with the Koopman Operator

Using the Koopman operator, nonlinear systems can be expressed as infinite-dimensional linear systems. Data-driven methods can then be used to approximate a finite-dimensional Koopman operator, which is particularly useful for system identification, control, and state estimation tasks. However, approximating large Koopman operators is numerically challenging, leading to unstable Koopman operators being identified for otherwise stable systems. Presented are a selection of techniques to regularize the Koopman regression problem, including a novel H-infinity norm regularizer. The authors' open-source Koopman operator identification library, pykoop, is also presented.

Rosnel Sessinou - Postdoctoral fellow, Decision Sciences (HEC), under the supervision of David Ardia
Title of the presentation: When systemic risk meets post-selection inference



I show that if predictable factors determine stock market returns, Granger's conditional causality tests allow us to estimate the interconnectedness of financial networks. The density of this network is strongly positively correlated with the level of uncertainty in the market. Financial and economic crises correspond to a collapse of network interconnection. The implications for market regulation are discussed, and these theoretical results are confirmed by real data analysis. Focusing on non-financial institutions, I show that they provide early warning indications of financial bubble explosions.

2:00 – 2:15: Atrium
Healthy Break

2:15 – 3:15: Room 1502.1
Health and Artificial Intelligence

Jérôme St-Jean - MSc student, Neuroscience (Université de Montréal), under the supervision of Elie Bou Assi
Title of the presentation: *Vêtements connectés et méthodes d'intelligence artificielle pour la détection de crises épileptiques*

L'épilepsie est une condition neurologique caractérisée par des crises spontanées récidivantes. Malgré les nombreux médicaments antiépileptiques disponibles, plus du tiers des patients continue à présenter des crises invalidantes, souvent accompagnées de blessures et parfois même de mort subite par arrêt cardio-respiratoire. Notre groupe développe un système de détection de crises basés sur des méthodes d'intelligence artificielle (IA) à partir de signaux électrophysiologiques (signaux respiratoires, cardiaques et accélération) non invasifs captés par le chandail Hexoskin. L'objectif principal de ce projet est de développer des méthodes de détection de crises d'épilepsie basées sur des signaux multimodaux enregistrés à l'unité de monitoring d'épilepsie.

Ammar Alshegri - Postdoctoral fellow, Computer and Software Engineering (Polytechnique Montréal), under the supervision of François Guibault and Farida Cheriet
Title of the presentation: *3D Deep learning for feature line extraction from surfaces of prepared teeth for crown reconstruction*

Dental crowns are essential dental treatment for restoring missing teeth. Recent design of crowns is carried out using commercial dental design software. Once a die scan is uploaded, technicians manually define a margin line which constitutes an inconsistent procedure. The successful identification of the margin line is essential for the success of the dental crown. This work proposes a framework to create margin lines



automatically. A small dataset is used to train a deep learning segmentation model to segment the margin faces. A spline is interpolated through the centers of margin faces to predict the margin line.

Zichao Yan - PhD student, Computer Science (McGill), under the supervision of Mathieu Blanchette

Title of the presentation: Integrated pretraining with evolutionary information to improve RNA secondary structure prediction

RNA secondary structure prediction is a fundamental task in computational molecular biology. While machine learning approaches in this area have been shown to improve upon traditional RNA folding algorithms, performance remains limited for several reasons such as the small number of experimentally determined RNA structures and suboptimal use of evolutionary information. To address these challenges, we introduce a practical and effective pretraining strategy that enables learning from a larger set of RNA sequences with computationally predicted structures and in the meantime, tapping into the rich evolutionary information available in databases such as Rfam. Coupled with a flexible and scalable neural architecture that can navigate different learning scenarios while providing ease of integrating evolutionary information, our approach significantly improves upon state-of-the-art across a range of benchmarks, including both single sequence and alignment based structure prediction tasks, with particularly notable benefits on new, less well-studied RNA families, and at discovering pseudoknots and non-canonical RNA basepairs.

Alexis Leconte - MSc student, Biomedical Engineering (Polytechnique Montreal), under the supervision of Jean Provost

Title of the presentation: Microscopie de localisation ultrasonore dynamique rapide in vivo à l'aide de la détection spatio-temporelle

La microscopie de localisation ultrasonore dynamique (DULM) est une technique d'imagerie permettant la réalisation de films de pulsativité du réseau microvasculaire cérébral avec une résolution de quelques microns. DULM est basée sur la détection et le suivi de centaines de microbulles préalablement injectées dans le sang. Or augmenter le nombre de bulles détectées permet d'améliorer la résolution des films. Actuellement, les microbulles sont localisées dans l'espace puis appariées dans le temps pour former des trajectoires. Nous proposons de changer cette approche pour évaluer directement les trajectoires des bulles en considérant l'information spatio-temporelle permettant ainsi d'augmenter le nombre de bulles détectées.



2:15 – 3:15: Room 3561
Smart Cities and Societies

Charlie Gauthier - MSc student, Computer Science and Operational Research (Université de Montréal), under the supervision of Liam Paull
Title of the presentation: By fear and by woe: fearful exploration for reliable robots

Reinforcement Learning policies for RL robots have recently become tractable. But there are still many instability issues when it comes to their training. By leveraging a "fear network" that learns to predict crashes, we force the robots to learn about their own mortality. In doing so, we obtain good decision policies much more reliably.

Dmytro Humeniuk - PhD student, Computer and Software Engineering (Polytechnique Montréal), under the supervision of Foutse Khomh
Title of the presentation: Reinforcement learning assisted evolutionary search for autonomous systems testing

Recently a number of evolutionary search-based techniques were successfully applied to test case generation for autonomous systems. The main limitation of these approaches is the use of the computationally expensive full system model to perform the fitness function. In our work we study the possibility of using reinforcement learning (RL) to guide the genetic algorithm towards better solutions when applied to autonomous systems test case generation. The intuition is that we can first learn some of the environmental constraints of the problem with RL agent and apply this knowledge to guide the search algorithm. We evaluate the simple genetic algorithm and RL assisted genetic algorithm on to case studies, such as road topology generation for autonomous vehicles and obstacle map generation for autonomous robots.

Istvan David - Postdoctoral fellow, Computer Science and Operational Research (Université de Montréal), under the supervision of Eugène Syriani
Title of the presentation: Inference of Simulators in Digital Twins by Reinforcement Learning

Digital Twins are virtual representations of physical assets used for real-time monitoring, control, and optimization. Simulators are extensively employed in Digital Twins to support real-time decision-making and the adaptation of the physical asset. Unfortunately, the inherent complexity of heterogeneous systems renders the manual construction of their simulators an inefficient endeavor, and often, the manual construction of simulators may not be feasible. This talk presents an approach for inferring simulation models of Digital Twins by reinforcement learning and the main challenges and opportunities ahead.



Ali Fakhri - MSc student, Civil Engineering (Polytechnique Montreal), under the supervision of James-A. Goulet

Title of the presentation: Bayesian neural networks for large-scale infrastructure deterioration models

Deteriorating infrastructure is an issue faced by many countries in the world. Monitoring and maintaining infrastructure is critical to prolonging its life, reducing economic costs, and ensuring public safety. A common approach used for monitoring structural condition is to conduct visual inspections. However, current models that use visual inspections along with the shared information between structures require significant computational time and resources. This project aims at addressing this limitation by proposing a faster and more scalable model. This new method will allow scaling the visual inspection-based deterioration models to infrastructure networks encompassing tens of thousands of structures.

3:15 – 3:45: Atrium
Networking Break

3:45 – 4:45: Room 1502.1
Tomorrow's Algorithms

Hamed Hojatian - PhD student, Electrical Engineering (Polytechnique Montréal), under the supervision of François Leduc-Primeau

Title of the presentation: Flexible Unsupervised Learning for Massive MIMO Subarray Hybrid Beamforming

Hybrid beamforming is a promising technology to improve the energy efficiency of massive MIMO systems. In particular, subarray hybrid beamforming can further decrease power consumption by reducing the number of phase-shifters. However, designing the hybrid beamforming vectors is a complex task due to the discrete nature of the subarray connections and the phase-shift amounts. Finding the optimal connections between RF chains and antennas requires solving a non-convex problem in a large search space. In addition, conventional solutions assume that perfect CSI is available, which is not the case in practical systems. Therefore, we propose a novel unsupervised learning approach to design the hybrid beamforming for any subarray structure while supporting quantized phase-shifters and noisy CSI. One major feature of the proposed architecture is that no beamforming codebook is required, and the neural network is trained to take into account the phase-shifter quantization. Simulation



results show that the proposed deep learning solutions can achieve higher sum-rates than existing methods.

Firmin Ayivodji - PhD student, Economics (Université de Montréal), under the co-supervision of Karim Chalak and Benoit Perron

Title of the presentation: Measuring Economic Activity using News-Based Sentiment Indices

This presentation evaluates the informational content of sentiment extracted from news articles about the state of the economy. First, I apply state-of-the-art deep learning and lexical-based techniques to construct a new high-frequency measure of sentiment indices embodied in a vast news corpus covering economic and financial articles in Canada from January 1977 to March 2022. These sentiment indices are constructed both at the provincial and national levels. Second, I document that the sentiment indices significantly correlate with contemporaneous key economic and financial variables such as GDP, inflation, housing prices, and unemployment. Third, this paper provides novel evidence of how news sentiment tracks current economic and financial conditions and significantly enhances predictive power in existing forecasting models.

Anirudha Kentur - MSc student, Computer Science and Operational Research (Université de Montréal), under the supervision of Karim Jerbi and Pierre Bellec

Title of the presentation: AI-based modeling of brain and behavior: Combining neuroimaging, imitation learning and video games

Recent advances in the field of Artificial Intelligence have paved the way for the development of novel brain encoding models. Artificial Neural networks (ANN) can be trained to replicate the properties of brain dynamics in a range of cognitive processes. Videogames provide a promising framework linking brain activity to individual behavior in a naturalistic setting. In this study, we aimed to use ANNs to model functional magnetic resonance imaging (fMRI) and behavioral gameplay data, which we collected while subjects played the Shinobi III videogame. Using imitation learning, we trained an ANN to play the game closely replicating the unique gameplay style of individual participants. We found that hidden layers of our imitation learning model successfully encode task relevant neural representations and predict individual brain dynamics with higher accuracy than various control models. In particular, the highest correlations between layer activations and brain signals were observed in somatosensory and visual cortices. Our results highlight the potential of combining imitation learning, brain imaging and videogames to uncover subject-specific relationships between brain and behavior.



Kellin Pelrine - PhD student, Computer Science (McGill), under the supervision of Reihaneh Rabbany

Title of the presentation: Party Prediction on Twitter

It is critical to understand the role of social media in political polarization and misinformation. However, to study how groups interact and conflict, and how information spreads within and between them, one first needs to know the groups. Although many studies rely on party prediction, there is no definitive method and little to no comparison between methods. We aim to fix that. We begin with the missing thorough comparison of existing approaches. We add approaches of our own that deliver strong performance while opening up new data types. Our extensive experiments provide insights for both applied and methodological research.

3:45 – 4:45: Room 3561
From Earth to Planets

Maria Sadikov - MSc student, Physics (Université de Montréal), under the supervision of Julie Hlavacek-Larrondo

Title of the presentation: Classifier les amas de galaxies avec des méthodes d'apprentissage automatique

Les amas de galaxies peuvent être séparés en deux catégories selon la distribution du gaz qu'ils contiennent: les amas à cœur froid et les amas à cœur non-froid. Les amas à cœur froid ont une interaction très particulière avec le trou noir supermassif au centre de l'amas, d'où l'intérêt de les étudier. Cependant, il faut d'abord différencier les deux catégories. Mon projet vise à concevoir un algorithme d'apprentissage automatique qui retourne la catégorie à partir d'une image en rayons-X de l'amas de galaxies. Le modèle sera entraîné et validé sur des images simulées, puis testé sur des images d'observation.

Ève Campeau-Poirier - MSc student, Physics (Université de Montréal), under the supervision of Laurence Perreault Levasseur

Title of the presentation: L'apprentissage automatique au service de la cosmologie en crise

Mon projet vise à déterminer le taux d'expansion de l'Univers à partir de lentilles gravitationnelles, soient des galaxies qui dévient la lumière traversant son champ gravitationnel. Le taux d'expansion de l'Univers cause actuellement une crise en cosmologie, car deux méthodes pour le mesurer donnent deux résultats différents. Recourir aux lentilles gravitationnelles éclaircirait ce désaccord, puisqu'elles sont indépendantes des deux méthodes en conflit. En revanche, l'analyse des lentilles



gravitationnelles est longue et fastidieuse, d'où l'intérêt d'appliquer l'apprentissage automatique au problème. J'ai donc entraîné un réseau de neurones à accomplir mon objectif et à évaluer la marge d'erreur sur sa prédiction.

Francis Banville - PhD Student, Biological Sciences (University of Montreal), under the supervision of Timothée Poisot

Title of the presentation: Comment les réseaux de prédateurs et de proies sont-ils organisés ? Une approche entropique pour prédire leur structure avec un minimum de biais

Autant en milieu aquatique que terrestre, les prédateurs et leurs proies forment des réseaux écologiques complexes dont la structure détermine le fonctionnement et la résilience des écosystèmes. Malgré la reconnaissance que la structure des réseaux écologiques est régulée par un ensemble de contraintes biologiques, le principe d'entropie maximale (MaxEnt), une méthode rigoureuse conçue spécifiquement pour l'étude de systèmes contraints, est rarement utilisé pour étudier les réseaux écologiques. Dans cette présentation, je ferai la démonstration du potentiel que recèle MaxEnt pour prédire plusieurs propriétés des réseaux écologiques de façon la moins biaisée possible et identifier les processus biologiques les façonnant.

Alice Doucet Beaupré - Postdoctoral fellow, Biological Sciences (Université de Montréal), under the supervision of Timothée Poisot

Title of the presentation: Unsupervised niche discovery in the distribution of the tiger mosquito (*Aedes albopictus*)

*The distribution of a species in niche space forms a rich and complex multivariate structure which often gets ignored by traditional ordination approaches. Here we present a novel generative model which automatically learns and summarizes this structure using a non-parametric Dirichlet process mixture of multivariate normal distributions. Surprisingly, we successfully close the hierarchy of hyperparameters in a principled way using three novel and simple hyperpriors, thus making our model completely parameter-free. Finally, we apply this model to the distribution of the tiger mosquito (*Aedes albopictus*) and uncover a patchwork of environmental and geographical niches.*

4:45 – 5:00: Atrium
Healthy Break



5:00 – 6:00: Room 1502.1
Health and Artificial Intelligence

Clémentine Courdi - PhD student, Sociology (Université de Montréal), under the supervision of Éric Lacourse

Title of the presentation: Understanding information about COVID-19: how reliability of favored sources and level of understanding influenced adherence to sanitary measures in Canada during the first year of the pandemic

This study explores how understanding of information and sources' reliability can influence adherence to health measures implemented by Canadian federal and provincial governments. Previous articles have highlighted the importance of promoting health literacy and minimizing misinformation to encourage higher adherence to key sanitary measures helping to prevent the spread of COVID-19. The data for this study was collected from a representative sample of 3617 Canadians, following a longitudinal design of 11 waves from April 2020 to April 2021. We examined adherence to sanitary measures in the long term by modelling latent trajectories of adherence to key sanitary measures (staying home, social distancing and mask wearing). We obtained models containing four trajectories of adherence for staying home and social distancing measures, and five trajectories for mask wearing. On average, trajectories of higher adherence were linear and regrouped over 80% of the population, while lower adherence trajectories showed more variation through time depending on the circumstances and regrouped only a small portion of the population. We then considered how the level of understanding of information and the level of reliability of sources most used can predict membership in adherence trajectories. Confounding variables such as age, gender, education, revenue, regions, immigration status and political identity were also considered. Overall, a low level of understanding does predict membership in lower adherence trajectories to sanitary measures. Information sources' reliability also had a significant effect, albeit less important, on adherence trajectories to some measures (staying home and social distancing), as individuals who trust mostly unreliable sources tend to follow lower adherence trajectories. These results highlight that it is essential to ensure good understanding of sanitary measures to promote adherence, regardless of the sources of information used by individuals.

Aaron Berk - Postdoctoral fellow, Mathematics and Statistics (McGill), under the supervision of Tim Hoheisel and Simone Brugiapaglia

Title of the presentation: Towards realistic sampling for generative compressed sensing

Compressed sensing (CS) gives theory for recovering unknown signals from optimal numbers of random measurements. With important applications in medical imaging, CS can perform impressively better than classical approaches: a CS MRI machine can be



more than five times as fast! Normally, compressed sensing relies on the idea that "wavelets" are good at representing natural images. However, modern neural networks seem to represent images much better than wavelets do. Therefore, using neural networks to represent images in medical CS might improve performance or image quality. To this end, we show that a popular set of neural networks performs near optimally for one kind of medical image compressed sensing.

Mohammed Abda - PhD student, Mechanical Engineering (Polytechnique Montreal), under the supervision of Frederick Gosselin
Title of the presentation: Learning physics from equations and data

A numerical model for a pipe conveying fluid will be built using physics informed neural network. The model will be validated with experimental data where test cases will aid the neural network to learn more about the behaviour of the pipe. Finally online training will be employed to create a digital twin in which a digital replica will behave in the same way as the physical model.

Simon Faghel-Soubeyrand - PhD student, Psychology (Université de Montréal), under the supervision of Frédéric Gosselin and Ian Charest
Title of the presentation: Loss of face identification abilities affect visual and semantic brain computations

Losing the ability to recognise the faces of colleagues, friends, and family members, a condition named prosopagnosia, has a profound psychosocial impact. Here, we aimed to identify the specific neural computations underlying the loss of this crucial ability by modeling the neural activity of brain-lesioned patient PS, a well-documented case of prosopagnosia. Using a combination of brain imaging and machine learning, we associate the brain function of PS and neurotypicals with those of neural networks models of vision and language-level semantics. This approach offers the first neuro-computational description of prosopagnosia, and opens paths to alleviate visual deficits through machine-learning aided neurofeedback.

5:00 – 6:00: Room 3561

From Earth to Planets / Smart Cities and Societies

Myriam Cloutier - MSc student, Biological Sciences (Université de Montréal), under the supervision of Etienne Laliberté and Mickaël Germain
Title of the presentation: Tree species segmentation on multitemporal high-resolution UAV imagery using convolution neural networks



The use of drones and remote sensing is booming in ecology. Combining these types of technologies with deep learning could allow researchers to map biodiversity in large or inaccessible places. We aimed to develop a deep learning model to classify temperate forest canopies at the species level using remote sensing imagery. Using multitemporal data, we would expect imagery from the fall to improve the model's performance due to tree species taking on more distinct colors in the fall. The use of remote sensing imagery and deep learning to identify species can lead to a better understanding of plant ecosystems.

Forough Majidi - PhD student, Computer and Software Engineering (Polytechnique Montréal), under the supervision of Foutse Khomh

Title: An Empirical Study on the Usage of Automated Machine Learning Tools

The popularity of automated machine learning (AutoML) tools in different domains has increased over the past few years. Machine learning (ML) practitioners use AutoML tools to automate and optimize the process of feature engineering, model training, and hyperparameter optimization and so on. Recent work performed qualitative studies on practitioners' experiences of using AutoML tools and compared different AutoML tools based on their performance and provided features, but none of the existing work studied the practices of using AutoML tools in real-world projects at a large scale. Therefore, we conducted an empirical study to understand how ML practitioners use AutoML tools in their projects. To this end, we examined the top 10 most used AutoML tools and their respective usages in a large number of open-source project repositories hosted on GitHub. The results of our study show 1) which AutoML tools are mostly used by ML practitioners and 2) the characteristics of the repositories that use these AutoML tools. Also, we identified the purpose of using AutoML tools (e.g. model parameter sampling, search space management, model evaluation/error-analysis, Data/ feature transformation, and data labeling) and the stages of the ML pipeline (e.g. feature engineering) where AutoML tools are used. Finally, we report how often AutoML tools are used together in the same source code files. We hope our results can help ML practitioners learn about different AutoML tools and their usages, so that they can pick the right tool for their purposes. Besides, AutoML tool developers can benefit from our findings to gain insight into the usages of their tools and improve their tools to better fit the users' usages and needs.

Xin Wang - PhD student, Decision Sciences (HEC Montréal), under the co-supervision of Erick Delage and Okan Arslan

Title of the presentation: Crowdkeeping in Last-mile Delivery

In order to improve the efficiency of the last-mile delivery system when customers are possibly absent for deliveries, we propose the idea of employing the crowd to work as



keepers and to provide storage services for their neighbors. Crowd-keepers have more flexibility, larger availability, and lower costs than fixed-storages, and this leads to a more efficient and a more profitable system for last-mile deliveries. We derive a bi-level program that jointly determines the assignment, routing, and pricing decisions while considering customer preferences, keeper behaviors, and platform operations. We present a numerical study involving a real-world dataset provided by Amazon.

Mengying Lei- PhD student, Civil Engineering (McGill), under the supervision of Lijun Sun and Aurélie Labbe

Title of the presentation: Bayesian Complementary Kernelized Learning for Multidimensional Spatiotemporal Data

Probabilistic modeling of multidimensional spatiotemporal data is critical to many real-world applications. However, real-world spatiotemporal data often exhibits complex dependencies that are nonstationary, i.e., correlation structure varies with location/time, and nonseparable, i.e., dependencies exist between space and time. Developing effective and computationally efficient statistical models to accommodate nonstationary/nonseparable processes containing both long-range and short-scale variations becomes a challenging task, especially for large-scale datasets with various corruption/missing structures. In this paper, we propose a new statistical framework—Bayesian Complementary Kernelized Learning (BCKL)—to achieve scalable probabilistic modeling for multidimensional spatiotemporal data. To effectively describe complex dependencies, BCKL integrates kernelized low-rank factorization with short-range spatiotemporal Gaussian processes (GP), in which the two components complement each other. Specifically, we use a multi-linear low-rank factorization component to capture the global/long-range correlations in the data and introduce an additive short-scale GP based on compactly supported kernel functions to characterize the remaining local variabilities. We develop an efficient Markov chain Monte Carlo (MCMC) algorithm for model inference and evaluate the proposed BCKL framework on both synthetic and real-world spatiotemporal datasets. Our results confirm the superior performance of BCKL in providing accurate posterior mean and high-quality uncertainty estimates.

6:00 – 6:30: Atrium Awards Ceremony

Videns Analytics Award for Best oral presentation – Smart Cities and Societies (\$1000)
CHUM Award for Best oral presentation – Health and Artificial Intelligence (\$1000)
GIRO Award for Best oral presentation – Tomorrow's Algorithms (\$1000)
NorthStar Award for Best oral presentation – From Earth to Planets (\$1000)
Ericsson Award for Best Oral Presentation – Flash Presentations (\$500)



Ericsson Award for Best Poster Presentation – Undergraduate (\$500)
Intact Award for Best Poster Presentation – Graduate and Postdoctoral (\$500)
Hydro-Québec Award for Best oral presentation – Public's Choice (\$500)

6:30 – 7:30: Atrium
Networking Mocktail

Guest mixologists will be present to introduce you to non-alcoholic mocktails and small bites will also be served.

