Samuel Laferrière

Contact Information	495 Valery Brossard, QC J4W 1V5, Canada	+1 (514) 554-1259 samlaf92@gmail.com http://samlaf.github.io/

Education

University of Montreal / Montreal Institute for Learning Algorithms.   2017 − 2019
M.Sc. in Machine Learning. Developed a hierarchical bayesian optimization approach for cortical stimulation in rats and monkeys (see publications). Relevant classes taken: Deep Learning, Probabilistic Graphical Models, Duckietown (Autonomous Vehicles), Bayesian Inference, Dynamical Systems (non-linear ODEs), Advanced Structured Prediction and Optimization

McGill University. Montreal, QC, Canada.   2012 − 2015
B.Sc. Joint Honours in Mathematics & Computer Science (CGPA: 3.84/4.0)

Work Experience

ElementAI. Computer Vision Internship. Montreal.   May 2018 − September 2018
Visual Domain Adaptation Research. Adapted and benchmarked semi-supervised techniques for Syn2Real image classification tasks. Learned industrial coding practices, software workflow (tmux, Docker, virtualenv, SLURM, etc.) and how to distribute deep learning code on GPU clusters.
University of Montreal TA for IFT6390 - Fundamentals of Machine Learning   Fall 2018
Mila Supervised two professional masters students' summer internships, one on time-series prediction for finance, and the other on ML for natural language understanding. Summer 2019

Research

Robotics and Embodied AI Lab (REAL) and **DECAR Systems Group**.   Jan - Sept 2020
Developed and implemented Koopman-based control algorithms for self-driving cars and quadrotors in simulation. Supervised by Liam Paull and James Forbes.

Robotics Skills

Mechanics: Graduate-level understanding of Lagrangian and Hamiltonian Mechanics. Able to derive equations of motion for: simple and double pendulum, acrobot, cart-pole, quadrotors, and multiple bicycle/car models.
Estimation: Proficiency in Linear and Nonlinear dynamical systems, Knowledge of and ability to implement Bayesian, Kalman, Extended, Unscented, and Particle Filters, Implemented graph-based SLAM using SAM library.
Control: Implemented and mastered: (partial) feedback linearization, PID, LQR, Ricatti Equations, Energy Shaping, Differential Flatness, Lyapunov Stability Analysis
Optimal Control/RL: Proficiency in (discrete-time) DP and (continuous-time) HJB equation. Competency in nonlinear programming and trajectory optimization techniques. Expert understanding (but never implemented) deep RL algos: DDPG, A2C, SAC, PPO/TRPO.
Theory: Graduate-level understanding of Manifolds, Lie Groups, and their use in robotics and manipulation (eg. Product of Exponentials parameterization), functional analysis, and its use in Koopman-based control algorithms and Bayesian Optimization, nonparametric regression and kernel methods, with applications to System Identification.

Programming and Software

Languages: (Expert) Python, Matlab · (Comfortable) Scheme, C/C++ · (Familiar) Haskell, Java
Python Libraries: (Expert) Pytorch, Matplotlib, Numpy, Scikit-Learn, Scipy.integrate, Python Control

Packages/Platforms: (Expert) bash scripting · (Comfortable) Drake - Model-based Design for Robotics · (Familar) Docker, ROS

Open Source Contributions	**Python Control Library** Implemented a consistent naming convention for hierarchical systems and signals in the python control library. See pull request.

Summer Schools

University of Southern California. Summer School on Cognitive Robotics.   Summer 2019
One week course to help catalyze the next generation of researchers in AI and robotics, to work together to develop robots that are capable at both the task and motion levels.
CIFAR. Deep Learning + Reinforcement Learning Summer School.   Summer 2020
DLRL brings together graduate students, post-docs and professionals to cover the foundational research, new developments, and real-world applications of deep learning and reinforcement learning.

Publications Preprints

[1] Samuel Laferrière, Marco Bonizzato, Numa Dancause, Guillaume Lajoie Learning to evoke complex motor outputs with spatiotemporal neurostimulation using a hierarchical and adaptive optimization algorithm. bioRxiv 662072; doi: https://doi.org/10.1101/662072. Accepted as a poster at Computational Cognitive Neuroscience (CCN) 2019 conference.
[2] S. Laferrière, M. Bonizzato, S. L. Côté, N. Dancause and G. Lajoie, "Hierarchical Bayesian Optimization of Spatiotemporal Neurostimulations for Targeted Motor Outputs," in IEEE Transactions on Neural Systems and Rehabilitation Engineering, vol. 28, no. 6, pp. 1452-1460, June 2020, doi: 10.1109/TNSRE.2020.2987001.
[3] Samuel Laferrière, Marco Bonizzato, Numa Dancause, & Guillaume Lajoie, Bayesian optimization for automated neurostimulation: future directions and challenges. IEEE Brain Brain-Insight, Issue 2, 2020
[4] Samuel Laferrière. Hierarchical Bayesian optimization of targeted motor outputs with spatiotemporal neurostimulation. Master's Thesis. December 2019.

Scholarships

UNIQUE PhD Excellence Scholarship. Montreal. *$15,000*   January 2020
Chinese Government Scholarship. Peking University.   2015-2016 school year
One year program to study Chinese. Reached intermediate-advanced proficiency.
NSERC Undergraduate Student Research Award. Kyoto University.   Summer 2014
Graph Theory with Professor Bruce Reed.
ISM Undergraduate Summer Scholarship. UQAM University, Montreal.   Summer 2013
Survey of Riemann-Roch Theorem with Professor Frédéric Rochon.

Talks Given

The Roles of Supervised Machine Learning in Systems Neuroscience   Mila, May 2019
Basal Ganglia and RL   Mila, September 2019
Free Energy Principle, Bounded Optimality, Control-as-inference, and all that: is RL built on the wrong foundations   Mila, October 2019
Information theoretical toolbox   SOCML, Nov 2019

Languages   French (native) · English (fluent) · Chinese (Intermediate) · Japanese (Beginner)