Bassel El Mabsout

Curriculum Vitae

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EDUCATION

Ph.D. candidate in Computer Science **2018 – Present**
Boston University
Advisor: Dr. Renato Mancuso

M.S in Computer Science **2022**
Boston University

B.S. in Computer Science **2012 – 2015**
American University of Beirut

RESEARCH INTERESTS

My research focuses on enabling roboticists to **faithfully** translate high-level objectives into **robust** learned behaviors, particularly for *resource-constrained* robotic systems. By combining programming languages and machine learning techniques, I develop methods to synthesize controllers that perform **reliably** in real-world environments. My work emphasizes principled *adaptation* and *sim-to-real* transfer approaches to ensure learned controllers maintain their intended behavior when deployed.

My topics of interest include:

Reinforcement Learning ◇ Embedded Systems ◇ Type Theory ◇ Metaheuristics ◇ Control systems

PUBLICATIONS

[1] **Mabsout B.*** ◇ Mysore S.* ◇ Saenko K. ◇ Mancuso R. **2021**
How to train your quadrotor: A framework for consistently smooth and responsive flight control via reinforcement learning
ACM Trans. Cyber-Phys. Syst., 5(4): 10.1145/3466618 ◇ **website:** cpslab.bu.edu/projects/httyq

[2] **Mabsout B.*** ◇ Mysore S.* ◇ Saenko K. ◇ Mancuso R. **2021**
Regularizing Action Policies for Smooth Control with Reinforcement Learning
ICRA: 10.1109/ICRA48506.2021.9561138 ◇ **website:** cpslab.bu.edu/projects/caps/

[3] Mysore S. ◇ **Mabsout B.** ◇ Mancuso R. ◇ Saenko K. **2021**
Honey. I Shrunk The Actor: A Case Study on Preserving Performance with Smaller Actors in Actor-Critic Reinforcement Learning
IEEE CoG: 10.1109/CoG52621.2021.9619008

[4] **Mabsout B.** **2023**

Tree Shaping, a solution to the expression problem showcased via a compiler for a programming language named Puler
Masters Thesis, Boston University: hdl.handle.net/2144/49330 ◇ **github:** bmabsout/puler

* Authors contributed equally

ONGOING RESEARCH

Anchored Learning for On-the-Fly Adaptation **Submitted**

A novel strategy for enhancing the robustness of reinforcement learning agents in crossing the sim-to-real gap. Our method maximizes multiple Q-values across domains, ensuring high performance in both simulation and reality, achieving a near-50% reduction in power consumption while maintaining controllable, stable flight
arXiv: 2301.06987 ◇ **github:** bmabsout/AnchoredActorCritic

Expressive Reinforcement Learning via Algebraic Q-Value Scalarization **Submitting**

We introduce Algebraic Q-value Scalarization (AQS), a novel domain-specific language for specifying policy behavior. AQS generalizes linear utilities by employing the power-mean as a logical operator over normalized Q-values. By specifying how different policy objectives interact, users can intuitively design policy losses
github: bmabsout/AQS

Scrap Your Schedules with PopDescent **Submitted**

A novel population-based hyperparameter optimization method which adaptively controls hyperparameter selection via a normalized fitness function. The method combines the exploration benefits of evolutionary algorithms with the exploitation of gradient descent, outperforming existing methods by up to 18% in test loss
arXiv: 2310.14671

Adaptive Lyapunov-based controller learning **Ongoing**

We construct learned controllers using quickly converging learned bounded Lyapunov functions for maintaining stability under multiple complex dynamical systems at the same time. This technique is then used to take advantage of learned dynamics as well as idealized models, improving the probability of stabile and high-performance control when deployed in the real world
github: bmabsout/SystemDescent

Risk-aware path planning using 2D-Gaussian mixtures **Ongoing**

In order to maximize the safety and performance of autonomous vehicles, we propose a risk-aware path planning framework that uses 2D-Gaussian mixtures. We propose an efficient method for computing the risk of trajectories allowing for real-time sampling and optimization on computationally constrained F1tenth vehicles
github: bmabsout/gaussian_racer_jax

SELECTED PROJECTS

Stochastic dynamics learning **BU/MIT**

Achieving safer learned model-based control requires accurate models, given most real-world systems are stochastic, we built Generative Adversarial Networks which modeling the distribution of the system's

trajectories
github: bmabsout/swirls ◇ **github:** bmabsout/SystemDescent

Honda Ridesharing **SAIL**

In collaboration with BU's SAIL and Honda, we worked on privacy preserving (using MPC) preferential ride-sharing. My responsibilities included defining optimization constraints so users with similar preferences get pooled together

Seizure Prediction **Machine learning – CS542**

A Kaggle competition project which accurately predicted seizure activity in epileptic patients. Utilizing machine learning techniques, we achieved the highest score with a significant margin (AUC score of 0.92)
preprint: tinyurl.com/seizure-prediction

Finding a NASH-ε Equilibrium **Complexity Theory – CS535**

This term paper simplifies an existing proof of the complexity class specifying the run-time of finding approximate Nash equilibria
preprint: tinyurl.com/nash-complexity

Haskell Blog **Personal Blog**

I created a programming languages focused blog exploring geometry, automatic differentiation, and dependently typed vector construction. The blog garnered interest and was featured on Haskell Weekly
blog: bmabsout.com/blog

WORK EXPERIENCE

Freelancer *Scanman* **2020 – Present**

Developed a full-stack inventory management system combining React Native barcode scanning and real-time web dashboard for inventory tracking. System acquired by Meathouse for supply chain management. Managed 2 developers.

Cofounder/CTO *Zahera* **2018 – 2022**

Led development of an app-based photo printing service reaching over 15,000 installations. Managed product design, technology stack, and 3 developers
instagram: @zahera_me

Researcher *American University of Beirut* **2016 – 2018**

Developed *neural-swarm*, a collection of experimental optimization algorithms for learning decentralized swarm control systems using neural networks, implemented in Haskell
github: neural-swarm

Software Developer *CCC* **2015 – 2017**

Core team member of C3D, a leading 3D construction project control application designed for energy projects. I performed optimizations that improved performance by 2000%, refactored main architectural components of the huge codebase increasing maintainabilility and type-safety, and implemented bug fixes in Java. I also contributed to JFoenix
website: cctintl.com/solutions/c3d-project-control.html

Mentorship

RISE Program *Boston University* **2021 – Present**

Mentored Abhinav Pomalapally in gradient-based optimization research, this work led to the population-based optimization paper. Provided recommendation letter leading to his admission to UC Berkeley. Led weekly reading groups on advanced topics in control theory and optimization.
linkedin: apomalapally

Kilachand Honors College Keystone Project *Boston University* **2023**

Advised Rithvik Doshi on embedded systems localization project. Implemented pedestrian detection system using ESP32 Bluetooth modules and integrated RTK-GPS for precise positioning. This project was part of the explorations that evolved into building SafeSteps, a startup focused on pedestrian safety.
website: doshir.dev/about

Efficient RL *Boston University* **2021 – 2022**

Mentored Kathakoli Sengupta and Sandesh Bharadwaj in developing efficient reinforcement learning algorithms. Their work led to a paper accepted at ECCV 2024 titled "UniLCD: Unified Language-Conditioned Detection with Multimodal Queries" where I received an acknowledgement.
paper: UniLCD ◇ **Kathakoli (web):** diasengupta.github.io ◇ **Sandesh (linkedin):** bharadwaj97

BU Spark *Boston University* **2022 – 2023**

Supervised team of 5 students in building a 3d printed quadrotor which uses a jetson for onboard processing for research purposes. The quadrotor succesfully completed flight tests.

ACADEMIC SERVICES

Peer Review Venues

ICLR ◇ ICRA ◇ ROBOT ◇ EMSOFT ◇ COG ◇ DATE ◇ ECRTS ◇ RTSS ◇ TJCA

Teaching Experience

Course Instructor - CS 454/654 **2023**

Boston University

Created and supervised projects for 24 students in modeling and controlling AmazingBall System. Students' work led to research contributions while focusing on minimizing the sim2real gap. Developed comprehensive curriculum and mentored students through implementation challenges.

Press Releases

BU Hub Innovation Center **"Simplifying Machine Learning for Drone Flight Control"** **2021**

WASP Summer School **2023**

Presented research on reinforcement learning for quadrotor control

Galois Inc. **2023**

Presented work on formal verification of learned controllers

BU AIR **2022**

Presented research on quadrotor control and sim2real adaptation

BU Systems Seminar **2022**

Presented work on efficient reinforcement learning for embedded systems

HRI-EU **2021**

Presented research on smooth control via reinforcement learning

ICRA **2021**

Presented paper on regularizing action policies for smooth control

CoG **2021**

Presented work on actor size reduction in actor-critic RL

TECHNICAL SKILLS

Programming Languages

IMPERATIVE	C ◇ C++ ◇ Go ◇ Java ◇ Python
FUNCTIONAL	Haskell ◇ F# ◇ Clojure
THEOREM PROVERS	Rocq ◇ Lean ◇ ATS
WEB	JavaScript ◇ TypeScript ◇ Elm
DEVELOPMENT	SQL ◇ Nix ◇ Make ◇ Fish ◇ Bash
GRAPHICS	GLSL ◇ WGSL
MARKUP	LaTeX ◇ Typst ◇ HTML ◇ CSS ◇ XML ◇ Markdown

Frameworks & Libraries

ML	TensorFlow ◇ PyTorch ◇ JAX ◇ Keras
SCIENTIFIC	NumPy ◇ SciPy ◇ Pandas
ROBOTICS	Spinning Up ◇ PyBullet ◇ Gurobi
WEB	React Native ◇ Firebase
HASKELL	Megaparsec ◇ Recursion-Schemes ◇ Polysemy ◇ ImplicitCAD

Tools

DEVELOPMENT	Git ◇ Nix ◇ GNU Utils ◇ Make ◇ Docker
SOFTWARE	AutoCAD ◇ GIMP ◇ Photoshop ◇ Jupyter Notebook
HARDWARE	Soldering ◇ Oscilloscope ◇ Multimeter ◇ Lazer Cutter ◇ Embedded Systems

PERSONAL INFORMATION

Nationalities

Lebanese and Portuguese

Languages

English (Fluent), Arabic (Native), Portuguese (Intermediate)