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Séminaire conjoint CIRRELT, MobilOpt et la Chaire de recherche du Canada en logistique intégrée

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MobilOpt: Mobility Optimization

Smart Retraining of ReLU Neural Nets: Applications in Optimization and Control

Abstract: A ReLU network is a piecewise-affine map whose input space is partitioned by the training algorithm to minimize error. This differs from traditional piecewise-linear approximation, where partitions are defined by the designer or constrained by the data. Beyond automatic partitioning, ReLU networks can be cast as MILP formulations, enabling their use as surrogate models for complex nonlinear functions in mathematical optimization. In this talk, I present a reachability analysis algorithm for the formal verification of system properties, such as contractivity and positive invariance of ReLU networks in dynamic optimization, and the maximum approximation error of proxy models in static optimization. The analysis identifies faulty partitions, which are further sampled and retrained to validate the desired properties. Owing to the high computational cost of exhaustive analysis, we propose a stochastic sampling strategy to identify faulty partitions and guide retraining. We derive probability bounds for detecting faulty partitions based on their volume, providing probabilistic guarantees for the considered properties. The effectiveness of smart retraining is demonstrated in the formal verification of collision-free drones controlled by ReLU networks, and in ReLU proxy modeling of fluid flow for oil production optimization.

Short biography: Eduardo Camponogara received the Ph.D. degree in Electrical and Computer Engineering from Carnegie Mellon University in 2000. He is a Full Professor in the Department of Automation and Systems Engineering at the Federal University of Santa Catarina, Brazil. His publications have received awards from IEEE, IFAC, IISE, and SBC (Brazil). A Fulbright Scholar, Prof. Camponogara was a Visiting Professor at Stanford University in 2017 and at Carnegie Mellon University in 2018. His research interests include distributed optimization algorithms, mathematical optimization, and applications in transportation networks, energy systems, and oil and gas processes.

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MERCREDI / WEDNESDAY
4 MARS / MARCH 4TH
10h00

Université Laval
Pavillon Palasis-Prince
Salle / Room: 3215

Ouvert à tous / Open to all

Responsable / Organizer:
Leandro Coelho

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