L&LRS: Logic meets Learning

Thesis topic presentation

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Context

More and more reactive systems (e.g., self-driving cars. . .).
$\rightarrow$ Their correctness is often critical.
$\hookrightarrow$ Need for safe controllers.

How to obtain safe and optimal controllers?

Formal methods

Rigorous techniques based on mathematical tools.
$\rightarrow$ Reactive synthesis: from a specification, design a controller.

Machine learning

Powerful approach based on statistical reasoning.
$\rightarrow$ Reinforcement learning: train an agent based on a reward system.

Motivations

Formal methods	**Machine learning**
■ Exact	■ Good performances
■ Hard guarantees	■ Little guarantees
■ Poor scalability	■ Limited understandability

$\rightarrow$ Idea: combine formal methods and machine learning.

Current frameworks usually only permit to consider a single quantitative (or qualitative) aspect at a time.
$\hookrightarrow$ Need to model interplay between several aspects $=$ multi-objective.
$\rightarrow$ E.g., for an application, response time and energy consumption.

Objectives

Thesis goal

Combine the formal reasoning from logic and the power of learning, focusing on multi-objective models.

Three main dimensions:

1. Learning for multi-objective and/or exact models.
2. Safety and robustness.
3. Exploring understandable controllers.

$\rightarrow$ Software tool supporting our fundamental advances.

Thank you for your attention !