Comparing Probabilistic Logic Factored MDPs, CART and MLPs for Behavior Selection in Self-Driving Cars

Héctor Avilés[1], Verónica Rodríguez[2], Alberto Reyes[3], Rubén Machucho[1], Marco Negrete[5], Gabriel Ramirez[4], Karelly Rivera[1], Melchor Hernández[1], Omar Pérez[1], Gloria de-la-Garza[1], Sergio Vázquez[1], Alberto Petrilli[6]

Abstract

We present a comparative study of probabilistic logic factored Markov decision processes (*PL-fMDPs*), classification and regression trees (*CART*), and multi-layer perceptrons (*MLPs*) for behavior selection in self-driving cars. While CART and MLPs are widely used in decision-making, PL-fMDPs have been recently proposed for autonomous behavior selection with promising results. We carried out three main tests to evaluate these models: (i) learning and testing with examples taken from a simulated self-driving vehicle in a race-like scenario, (ii) comparison with actions of human drivers, and (iii) navigation of a self-driving car in two adverse and unknown road scenarios. In the first and third tests, CART slightly outperformed MLPs, and both narrowly surpassed PL-fMDPs. However, PL-fMDPs showed noticeably better alignment with the decisions of human drivers in the second test, at the cost of increased learning and testing time. The results demonstrate the competitiveness of all three approaches, although the definitive superiority of any one model was not observed across all evaluation contexts. This reinforces the need to explore hybrid approaches that combine symbolic, probabilistic, and connectionist models to leverage their respective strengths and mitigate their limitations for autonomous driving in self-driving cars.

Keywords: Self-driving cars, Factored Markov decision processes, Probabilistic logic, Neural networks, Decision trees

1 Introduction

Driving behaviors in self-driving cars are reactive, short-term maneuvers or actions (such as stopping, cruising, changing lanes, or braking) aimed to effectively and safely