Mobile Robot Self-Driving Through Image Classification Using Discriminative Learning of Sum-Product Networks

Undergraduate Thesis

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Abstract

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Driving has proven to be a very difficult task for machines to emulate, not only due to the inherent complexity of the problem but also because of the need for accurate real-time predictions. Nonetheless, recent advances in computer vision and machine learning have shown promising results in real-world applications. Mobile robots are low-cost small robots with limited processing power and memory. The problem of self-driving can be similarly applied to the mobile robot domain as a down-scaled version of the same task, with an additional hardware constraint. Sum-product networks are probabilistic graphical models capable of representing tractable probability distributions containing a great number of variables. Exact inference is asymptotically linear to the number of edges in the network's graph, and its deep architecture is capable of representing a wide range of distributions. In this work, we attempt to model autonomous driving by using sum-product networks on a small mobile robot. We model this task as an imitation learning problem through image classification. We present accuracy results on an artificial self-driving dataset for different sum-product network learning algorithms, providing a comparative study not only for different network architectures, but also discriminative and generative models. Finally, we provide a real-world mobile robot implementation on a miniature computer.

Keywords: sum-product networks, machine learning, robotics

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