Advances in Robotic Learning Paper Summary: Learning to Plan with Logical Automata

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Presented by: Frank Liu, Evan Lam, Michael Drolet

***Abstract*— This electronic document is a live template. The various components of your paper [title, text, heads, etc.] are already defined on the style sheet, as illustrated by the portions given in this document.**

I. INTRODUCTION

Imagine learning a skill like driving. In order to drive properly you not only need to learn how to drive a car, but also learn the rules of the road. To learn how to drive a car, many of us practiced driving and learning all the mechanics to make the car move. Most of us went to a driving school, where a driving instructor taught us certain driving rules in the United States. Others might watch instructional videos from experts online. One way or another, we developed a mental model of the rules of the road through imitating an expert.

Now there are two parts to this learning. The first part is learning the lower level actions in order to operate and drive a car. The second part is developing a mental model or representation of an interpretable policy, such as the rules of the road. The structure of the learned policy should be grounded in meaningful interpretations.

When learning the rules of the road, a naive assumption is that all experts have taught properly and that all the instruction received is correct. If there are bad or even illegal driving habits, these will need to be corrected to ensure safe driving. In real life if a person runs a red light or makes illegal u-turns, after a certain point a police officer would come and help correct that behavior (through a ticket or more serious consequences). We are able to be corrected because the rules in our heads are manipulable, where a human operator can easily modify a learned policy to perform similar but different policies.

Applying this to robotic learning, the authors work towards teaching a robot to learn from demonstrations not just a low-level policy, but also a high level policy that is interpretable and manipulable. The authors create a Logic-based Value Network (LVIN) which utilize these two principles in learning policies. The policies that a robot learns should be interpretable, where there is a set of learned representation of rules. The behavior of the robot should be manipulable, where the rules can be changed in a predictable way which results in changed behavior. The LVIN model is a recurrent, convolutional neural network which uses value iteration over a learned Markov Decision Process (MDP). This MDP factors into two seperate parts, the first as a finite state automaton (FSA) corresponding to the low-level policy, and a bigger MDP corresponding to the rules in an environment.

A big benefit to this approach to learning is that a robot won't just learn from demonstrations, but can modify the learned policy to be safe. Going back to the driving example, but this time with a robot, if a robot was learning the rules of the road and five percent of the training data included say illegal left turns which results in crashes then the robot would learn the policy which crashes five percent of the time. With the author's approach in robotic learning, such a policy can be corrected to stop the crashes. These rules can also be applied in many alternative scenarios.

In this paper, the authors main contributions are

1) A Logic-based Value Network (LVIN) model which learns policies for robotic learning with an imitation learning goal. The authors show the effectiveness of the LVIN model through four different benchmark scenarios.
2) The authors show that the model can learn the transitions from state to state, showing that it can interpret the rules.
3) The authors show that the learning is manipulable, thus generalizing to other tasks and fix mistakes without extra training or experts.

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$$\alpha + \beta = \chi \tag{1}$$

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TABLE I

An Example of a Table

One	Two
Three	Four

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Fig. 1. Inductance of oscillation winding on amorphous magnetic core versus DC bias magnetic field

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APPENDIX

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ACKNOWLEDGMENT

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References are important to the reader; therefore, each citation must be complete and correct. If at all possible, references should be commonly available publications.

REFERENCES

[1] G. O. Young, Synthetic structure of industrial plastics

[2] W.-K. Chen, Linear Networks and Systems (Book style). Belmont, CA: Wadsworth, 1993, pp. 123135.