

Abstract

abstract in German in at least 500 words is a requirement!!!

optionally also in English

write this last with introduction

Contents

1	Introduction	1
2	Background on Formal Languages	2
3	Background on Reinforcement Learning	3
4	Reward Machines	4
5	Conclusion & Outlook	5
	References	6
A	Appendix	7

1 Introduction

write this last with abstract

2 Background on Formal Languages

write after two other chapters (15-20 pages)

preliminaries to cover:

- regular languages (LTL, regular expressions)
- (deterministic) finite state automata (DFA)
- mealy/moore machines
- büchli automata

3 Background on Reinforcement Learning

write this first (10-15 pages)

include RL framework graph with agent and environment and include example of a typical RL task

preliminaries to cover:

- MDP
- policy
- q function
- Bellman equations
- (off-policy) (tabular) q learning
- proofs of standard dynamic programming solutions
- DQN
- off-policy actor-critic approach: Deep Deterministic Policy Gradient (DDPG)

4 Reward Machines

write this after chapter 1 (15-20 pages)

use following papers:

- original reward machine paper from 2018 [1]
- connection to LTL from 2019 [2]
- newer reward machine paper from 2022 [5]

maybe relevant papers:

- connection to symbolic planning from 2019 [3]
- reward machines for partially observable RL from 2019 [4]

include updated RL framework graph to better differentiate that reward machines are not in the environment black box

include same task from previous chapter and how a reward machine for that might look like as a graph

include comparison graphs to standard algorithms

5 Conclusion & Outlook

write this after the main chapters

References

- [1] Rodrigo Toro Icarte et al. “Using Reward Machines for High-Level Task Specification and Decomposition in Reinforcement Learning”. In: *Proceedings of the 35th International Conference on Machine Learning (ICML)*. 2018, pp. 2112–2121. URL: <http://proceedings.mlr.press/v80/icarte18a.html>.
- [2] Alberto Camacho et al. “LTL and Beyond: Formal Languages for Reward Function Specification in Reinforcement Learning”. In: *Proceedings of the 28th International Joint Conference on Artificial Intelligence (IJCAI)*. 2019, pp. 6065–6073. URL: <https://www.ijcai.org/proceedings/2019/0840.pdf>.
- [3] León Illanes et al. “Leveraging Symbolic Planning Models in Hierarchical Reinforcement Learning”. In: *Proceedings of the Knowledge Representation and Reasoning Meets Machine Learning workshop at NeurIPS 2019*. 2019. URL: <https://www.cs.toronto.edu/~sheila/publications/illanes-et-al-rldm19.pdf>.
- [4] Rodrigo Toro Icarte et al. “Learning Reward Machines for Partially Observable Reinforcement Learning”. In: *Advances in Neural Information Processing Systems (NeurIPS)*. 2019, pp. 15497–15508. URL: <https://www.cs.toronto.edu/~sheila/publications/toro-et-al-neurips19.pdf>.
- [5] Rodrigo Toro Icarte et al. “Reward Machines: Exploiting Reward Function Structure in Reinforcement Learning”. In: *Journal of Artificial Intelligence Research (JAIR)* 73 (2022), pp. 173–208. URL: <https://doi.org/10.1613/jair.1.12440>.

A Appendix

experiments and code go here