

Atari Breakout with LTL_f / LDL_f Goals

Ivan Bergonzani, Michele Cipriano, Armando Nania

Professor: Giuseppe De Giacomo

Elective in Artificial Intelligence: Reasoning Robots
Department of Computer, Control and Management Engineering
Sapienza University of Rome

Introduction

Intro.

Non-Atari Breakout

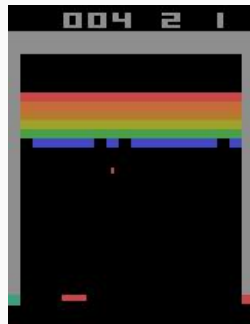
Results of the paper and our starting point.

Non-Atari Breakout (6×18)

Our results on 6×18 non-Atari Breakout + video.

Atari Breakout

Introduction to Gym + ALE
Differences with non-Atari Breakout (initial hypotheses)



Q-Learning brief description.

$$Q(S_t, A_t) \leftarrow Q(S_t, A_t) + \alpha \left[R_{t+1} + \gamma \max_a Q(S_{t+1}, a) - Q(S_t, A_t) \right]$$

SARSA brief description.

$$Q(S_t, A_t) \leftarrow Q(S_t, A_t) + \alpha \left[R_{t+1} + \gamma Q(S_{t+1}, A_{t+1}) - Q(S_t, A_t) \right]$$

LTL_f / LDL_f non-Markovian rewards + integration in our project.

Implementation

Algorithms.

Algorithms.

Algorithms.

Experiments

Experiments

All the experiments.

Conclusion

Conclusion.

Q&A

References i

-  G. Brockman, V. Cheung, L. Pettersson, J. Schneider, J. Schulman, J. Tang, and W. Zaremba, “OpenAI Gym,” 2016.
-  M. G. Bellemare, Y. Naddaf, J. Veness, and M. Bowling, “The Arcade Learning Environment: An Evaluation Platform for General Agents,” *Journal of Artificial Intelligence Research*, vol. 47, pp. 253–279, jun 2013.
-  R. S. Sutton and A. G. Barto, *Reinforcement Learning: An Introduction*.
The MIT Press, second ed., 2018.
-  G. De Giacomo, L. Iocchi, M. Favorito, and F. Patrizi, “Reinforcement Learning for LTLf/LDLf Goals,” *CoRR*, vol. abs/1807.06333, 2018.










V. Mnih, K. Kavukcuoglu, D. Silver, A. A. Rusu, J. Veness, M. G. Bellemare, A. Graves, M. Riedmiller, A. K. Fidjeland, G. Ostrovski, S. Petersen, C. Beattie, A. Sadik, I. Antonoglou, H. King, D. Kumaran, D. Wierstra, S. Legg, and D. Hassabis, “Human-level control through deep reinforcement learning,” *Nature*, vol. 518, pp. 529–533, Feb. 2015.



“Montezuma’s Revenge Solved by Go-Explore, a New Algorithm for Hard-Exploration Problems (Sets Records on Pitfall, Too).” <https://eng.uber.com/go-explore/>.

References iii

-  S. A. McIlraith and K. Q. Weinberger, eds., *Proceedings of the Thirty-Second AAAI Conference on Artificial Intelligence, (AAAI-18), the 30th innovative Applications of Artificial Intelligence (IAAI-18), and the 8th AAAI Symposium on Educational Advances in Artificial Intelligence (EAAI-18), New Orleans, Louisiana, USA, February 2-7, 2018*, AAAI Press, 2018.
-  “A Python Implementation of the FLLOAT library.”
<https://github.com/MarcoFavorito/flloat>.
-  “A library for generating automata from LTL and LDL formulas with finite-trace semantics in Python.”
<https://github.com/MarcoFavorito/pythomata>.
-  “Framework for Reinforcement Learning with Temporal Goals defined by LDLf formulas..”
<https://github.com/MarcoFavorito/rltg>.

-  G. Bradski, “The OpenCV Library,” *Dr. Dobb’s Journal of Software Tools*, 2000.
-  P. Dhariwal, C. Hesse, O. Klimov, A. Nichol, M. Plappert, A. Radford, J. Schulman, S. Sidor, Y. Wu, and P. Zhokhov, “OpenAI Baselines.” <https://github.com/openai/baselines>, 2017.
-  V. Mnih, A. P. Badia, M. Mirza, A. Graves, T. P. Lillicrap, T. Harley, D. Silver, and K. Kavukcuoglu, “Asynchronous methods for deep reinforcement learning,” *CoRR*, vol. abs/1602.01783, 2016.