

Constructivist Cognitive Architecture

Laboratoire d'InfoRmatique en Image et Systèmes d'information

Jianyong XUE

Supervisors: Salima Hassas, Olivier Georgeon



INSA



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Context

Context:

- Knowledge acquisition through developmental process is an active research area.
- Traditional AI approaches rely on an abstraction of the environment proposed by a system designer^[1]. Hence the agent's adaptation to different problems and complex environment is limited.
- Mastering the laws of feedback contingencies is essential to constructivist artificial agents^[2].
- Constructivist epistemology suggests an approach to make an autonomous agent iteratively construct a representation of an unknown environment^[3].
- Little AI: Playing a constructivist robot^[3].

Conceptions:

- Cognitive architecture^[4]
- The Constructivist Paradigm and the Realist Paradigm

[1] Guériau M, Armetta F, Hassas S, et al. A constructivist approach for a self-adaptive decision-making system: application to road traffic control[C], 2016 IEEE 28th International Conference on. IEEE, 2016: 670-677.

[2] Olivier L. Georgeon, Mathieu Guillermin. Mastering the laws of feedback contingencies is essential to constructivist artificial agents. Constructivist Foundations, 2018, 13 (2), pp.300-301.

[3] Georgeon, O. L. (2017). Little AI: Playing a constructivist robot. SoftwareX, 6, 161-164.

[4] Sun, R. (2004). Desiderata for cognitive architectures. Philosophical Psychology, 17(3), 341-373.

Objectives

Through my research, I hope to:

- Create an environment and the agent and analysis traces that the agent produces when interacting with the environment.
- Let the agent build knowledge about the environment and itself and to revise its behavior more quickly and efficiently by interacting with the environment to adapt to it.
- Transfer the agent to another new and more complicated environment, and extend the capabilities of the agent to adapt to different kinds situation environment.
- Build a more powerful cognitive architecture that can meet the needs of a single-agent and or of a multi-agent system.

Working of the first year

- The learning of MOOC on Developmental Artificial Learning and lectures on Developmental Learning.
- The research of radical constructivism^[5] and autonomous agent.
- Followed with the constructivist paradigm, we develop a self-motivated^[6] agent to construct causality from learning feedback of interactions with the environment.
- Inspired by Van der Aalst's α -algorithm^[7] and Georgeon et al. 's work^[8], the agent learns a Petri Net to explain causality and regularities of interactions.

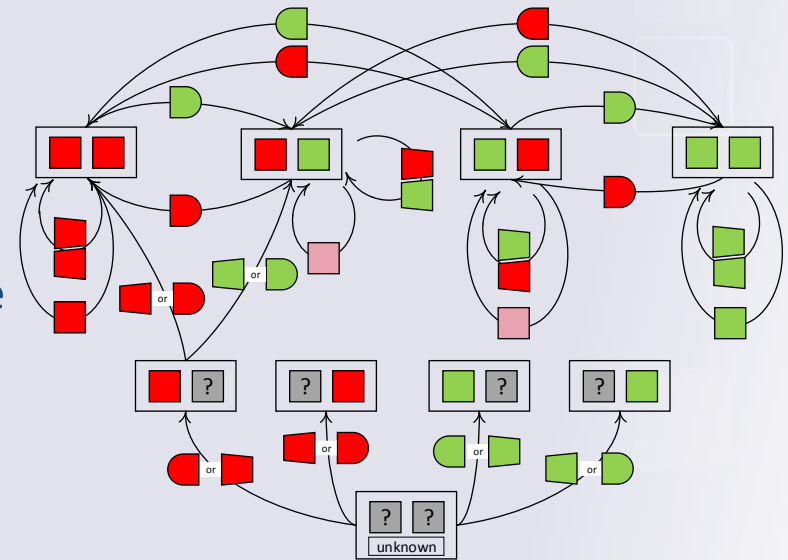


Fig. 1. Causal model (Petri Net) learned by the agent from regularities of interactions

[5] Von Glasersfeld, E. An introduction to radical constructivism. The invented reality, vol(1740) 1984.

[6] Oudeyer, P-Y., Jacqueline Gottlieb, and Manuel Lopes. "Intrinsic motivation, curiosity, and learning: Theory and applications in educational technologies." Progress in brain research. Vol. 229. Elsevier, 2016. 257-284.

[7] Van der Aalst, W. & Weijters, A. & Maruster, L (2003). Workflow Mining: Discovering process models from event logs, IEEE Transactions on Knowledge and Data Engineering, vol 16.

[8] Georgeon, O. L., Bernard, F. J., & Cordier, A. (2015). Constructing phenomenal knowledge in an unknown noumenal reality. Procedia Computer Science, 71, 11-16.

Conclusion and Perspective

The questions still remain:

1. The construction of spatial knowledge.
2. The petri-net will be too tremendous in more complex tasks.
3. low-level learning.

Future work will be mainly focused on:

1. Improve the learning efficiency by memorizing these patterns in the stream of interaction feedback traces.
2. Combination with biological inspirations (Place Cells, landmarks) to let the agent has capabilities of spatial cognition.
3. Research of Causality and hierarchical sequence learning for high-level learning.

Publications

- Jianyong XUE, Olivier Georgeon. Causality Reconstruction by An Autonomous Agent, 2018 Annual International Conference on Biologically Inspired Cognitive Architectures, Prague (Accepted for presentation in August 2018).

Thanks for your attention!