dBaby: Grounded Language Teaching through Games and Efficient Reinforcement Learning

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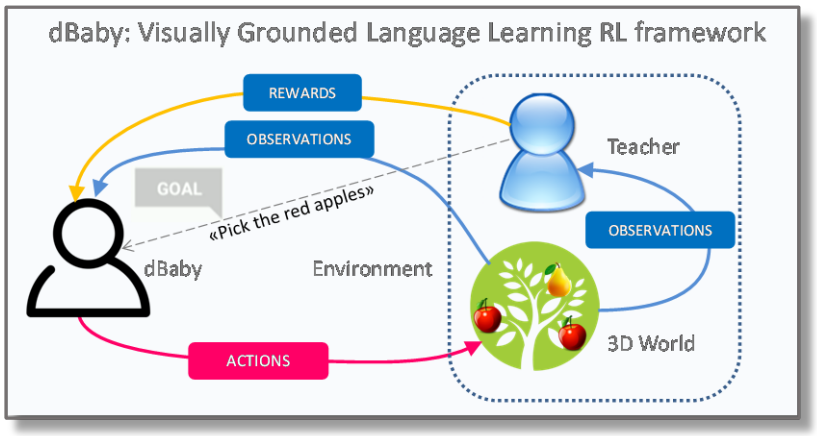
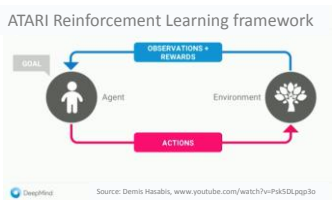
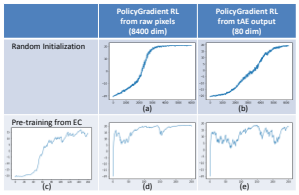
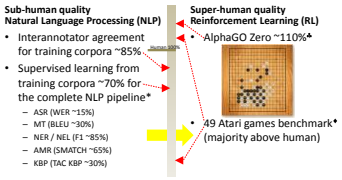
The purpose of the project[1] is to create a digital Baby (dBaby) – an agent perceiving and interacting with the 3D world and communicating with its Teacher via natural language phrases to achieve the goals set by the Teacher.

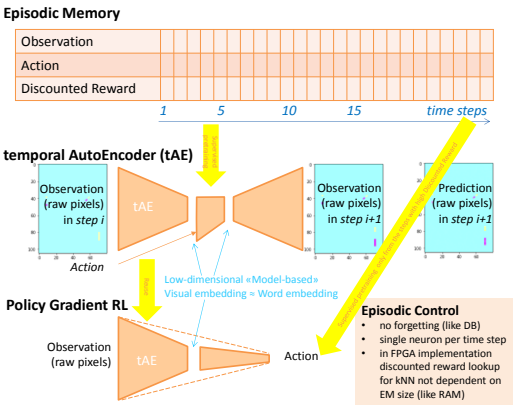


The novelty of the approach is that neither language nor visual capabilities are hard-coded in dBaby – instead, the Teacher defines a language learning Game grounded in the 3D world, and dBaby learns the language as a byproduct of the reinforcement learning from the raw pixels and character strings while maximizing the rewards in the Game.









So far such approach successfully has been demonstrated only in the virtual 3D world with pre-programmed Games where it requires millions of episodes to learn a dozen words. Moving to human Teacher and real 3D environment requires an order-of-magnitude improvement to data-efficiency of the reinforcement learning. A novel Episodic Control based pre-training is demonstrated as a promising approach for bootstrapping the data-efficient reinforcement learning.

The current statistical NLP tools that learn from text-only corpora suffer from the symbol grounding problem and thus are constrained by the training corpora inter-annotator agreement ratio. Genuine natural language understanding requires a different approach. Grounded language learning through reinforcement learning has recently emerged as a promising alternative and is at the core of the dBaby project proposal. The attractiveness of this approach is strengthened by the deep reinforcement learning recently demonstrating super-human capabilities both in Atari games and the very challenging game of GO allowing to speculate that someday dBaby might achieve super-human fluency in natural language.

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[1] This is a proposal for EC H2020 call ICT-29-2018 Available at: https://github.com/LUMII-AILab/dBaby