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Model-based Reinforcement Learning for Control Purposes

The idea behind reinforcement learning (RL) is very similar to human learning and therefore intuitive. Act, observe, evaluate the reward, and adjust your policy for enacting with the environment. With the growing power of computers, an enormous amount of trials can be carried out in simulation in a short amount of time. For example, the project OpenAI Five [2] gathered 180 years worth of playtime experience in one single day. With such computational power, agents (can be understood as controller) can be trained which surpass human abilities to fulfill tasks as playing Dota, Chess and Go (AlphaGo [3]).
In engineering RL is often considered unreliable since the agents fail to consistently perform well. Training might take too long and can often hardly be implemented in real environments. Brunnbauer et al. have shown promising results for model-based algorithms in comparison to model-free algorithms [1].

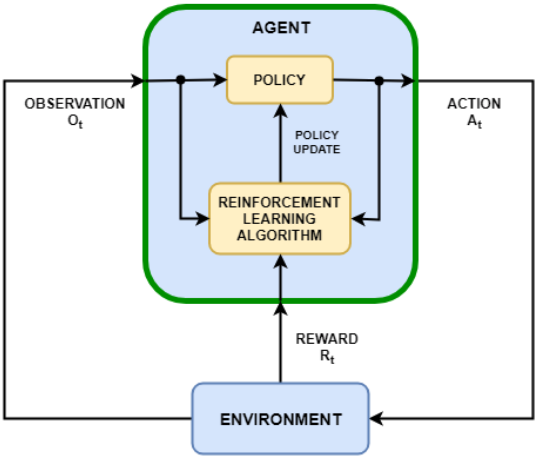

Figure 1: General structure of reinforcement learning; source: mathworks.com

In order to understand this better, a study about model-based RL algorithms needs to be done. Promising algorithms shall be investigated at simulated control problems and compared to model-free RL algorithms such as Deep Q-learning.

Tasks:

- Get familiar with model-based and model-free reinforcement learning
- Select several model-based RL methods for training agents
- Apply the methods to train agents for given applications (e.g. Cart Pole and 1-Q-Converter), preferably in Python
- Evaluate the outcome and compare it to model-free RL algorithms for the chosen applications

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References

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[2] OpenAI et al. *Dota 2 with Large Scale Deep Reinforcement Learning*. 2019. arXiv: 1912.06680 [cs.LG].

[3] David Silver et al. "Mastering the game of Go with deep neural networks and tree search". In: *Nature* 529.7587 (2016), pp. 484–489. DOI: 10.1038/nature16961. URL: https://doi.org/10.1038/nature16961.