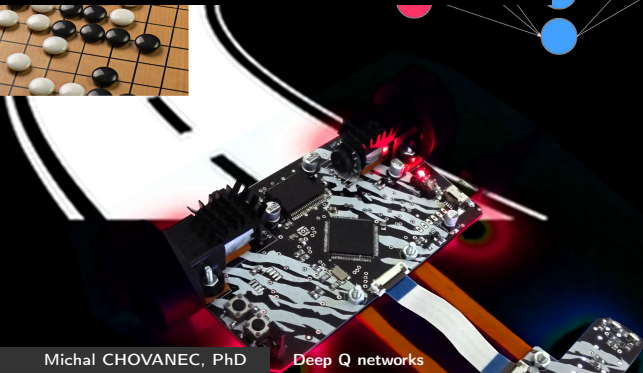
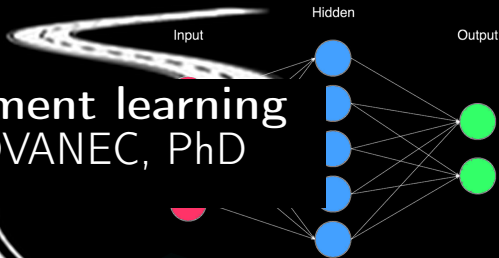


$$Q(s_t, a_t) \leftarrow Q(s_t, a_t) + \alpha [r_{t+1} + \lambda \max_a Q(s_{t+1}, a) - Q(s_t, a_t)]$$

(The New Action Value = The Old Value) + The Learning Rate \times (The New Information - the Old Information)

Reinforcement learning

Michal CHOVANEC, PhD



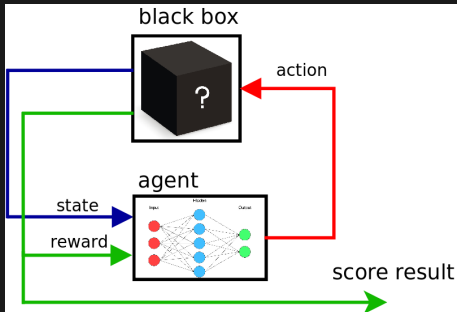
Reinforcement learning

- learn from punishment and rewards
- learn to play a game with unknown rules



Reinforcement learning

- obtain **state**
- choose **action**
- **execute** action
- obtain **reward**
- learn from **experiences**



Q learning

$$Q'(s, a) = R + \gamma \max_{a'} Q(s', a')$$

where

s is state

a is action

s' is next state

a' is best action in next state

$R(s, a)$ is reward

$\gamma \in \langle 0, 1 \rangle$ is discount factor

Deep Q network - DQN

$$\hat{Q}(s, a; w) = R + \gamma \max_{\alpha} \hat{Q}(s', \alpha; w),$$
$$\hat{Q}(s, a; w) = R + \gamma \max_{\alpha} \hat{Q}(s', \alpha; w')$$

Dueling deep Q network - DDQN

$$\hat{Q}(s, a; w) = \hat{V}(s, a; w) + \hat{S}(s, a; w)$$

$$\hat{Q}(s, a; w) = R + \gamma \max_{\alpha} \hat{Q}(s', \alpha; w),$$

$$\hat{Q}(s, a; w) = R + \gamma \max_{\alpha} \hat{Q}(s', \alpha; w')$$

Usefull links



Andrej Karpathy : Pong from pixels

<http://karpathy.github.io/2016/05/31/rl/>



Richard S. Sutton : Reinforcement Learning: An Introduction

[https:](https://www.amazon.com/Reinforcement-Learning-Introduction-Adaptive-Computation/dp/0262193981)

[//www.amazon.com/Reinforcement-Learning-Introduction-Adaptive-Computation/dp/0262193981](https://www.amazon.com/Reinforcement-Learning-Introduction-Adaptive-Computation/dp/0262193981)



Maxim Lapan : Deep reinforcement learning

<https://www.amazon.com/Practical-Reinforcement-Learning-Maxim-Lapan/dp/1788834240>



Mohit Sewak : Practical Convolutional Neural Networks

<https://www.amazon.com/Practical-Convolutional-Neural-Networks-Implement/dp/1788392302>



CHRISTOPHER J.C.H. WATKINS : Q-learning

<http://www.gatsby.ucl.ac.uk/~dayan/papers/cjch.pdf>



Densely Connected Convolutional Networks

<https://arxiv.org/pdf/1608.06993.pdf>



Mastering the Game of Go without Human Knowledge

https://deepmind.com/documents/119/agz_unformatted_nature.pdf

Q&A



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www.youtube.com/channel/UCzVvP2ou8v3afNiVrPAHQGg
github <https://github.com/michalnand>