

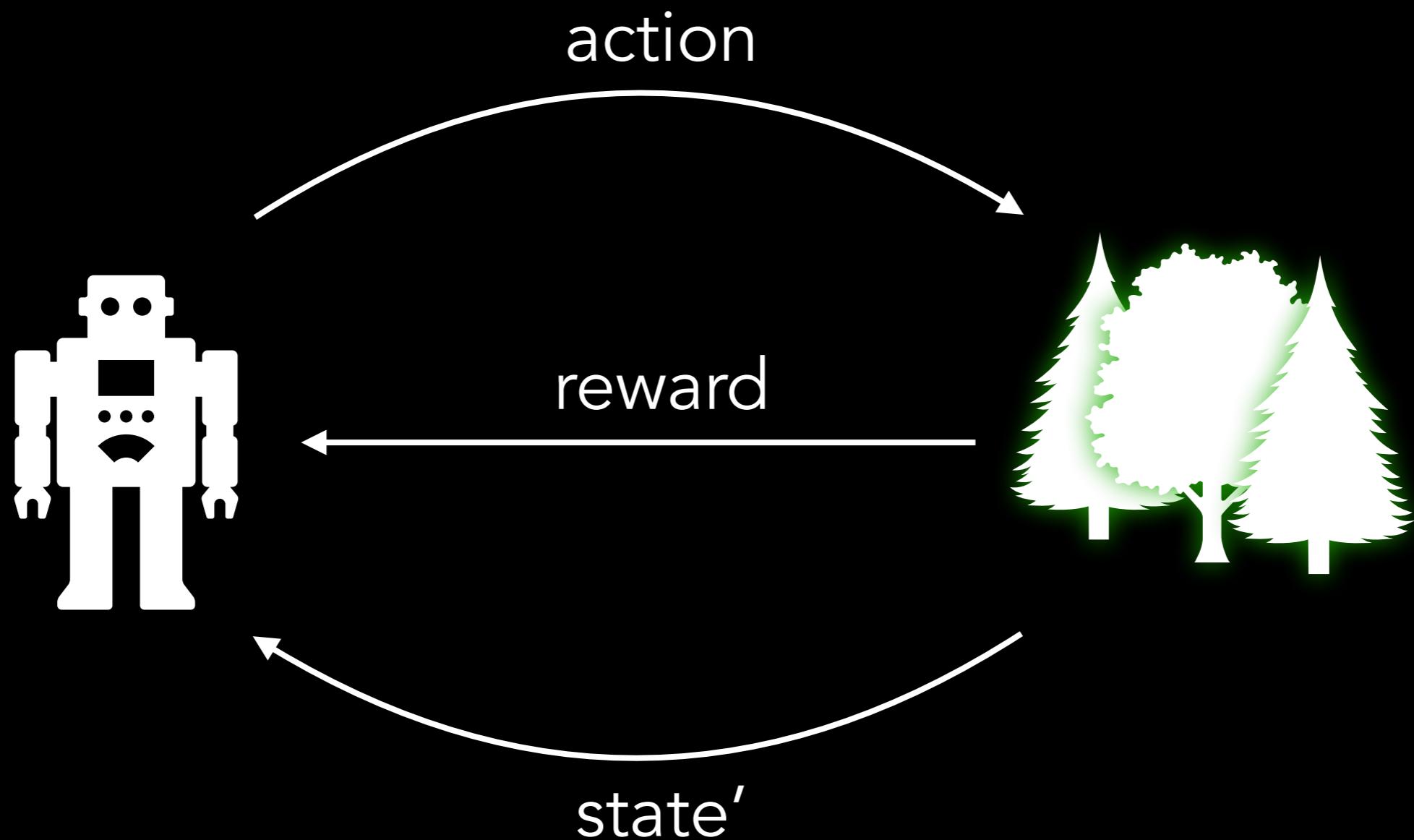
DEEP REINFORCEMENT LEARNING

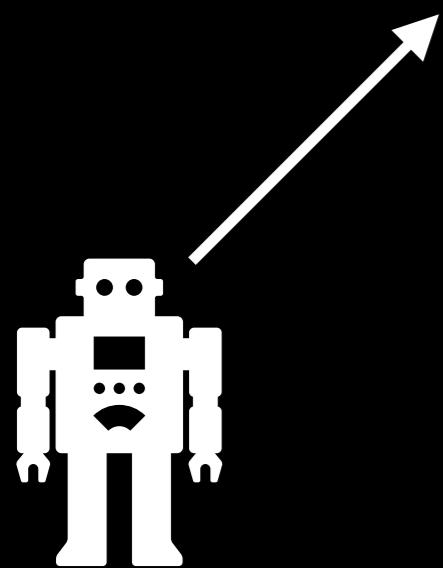
Applications in Cryptocurrency Trading

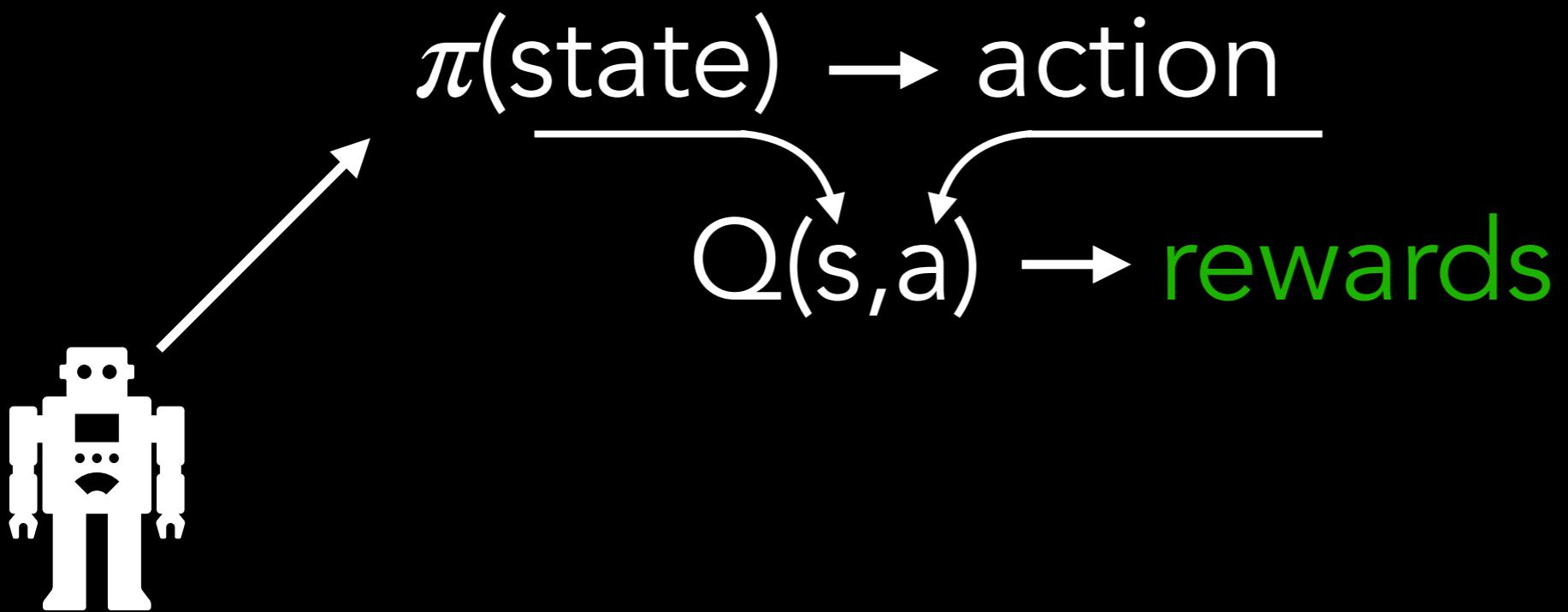
Mattson Thieme, CS496 Winter 2020

This talk

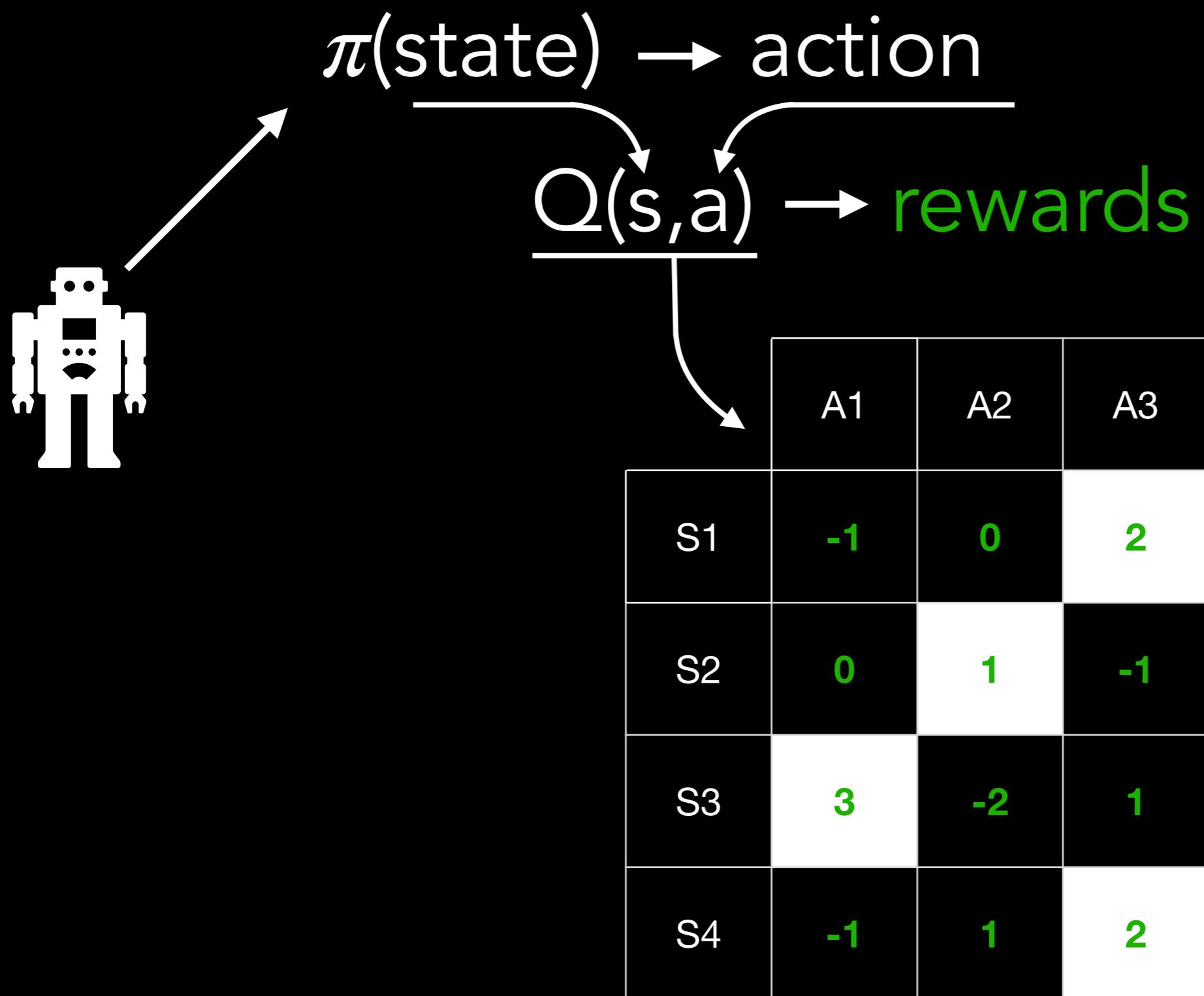
- Standard Q-Learning
- Deep Q-Learning
- Cryptocurrency markets



$\pi(\text{state}) \rightarrow \text{action}$ 







$$R_t = \sum_{k=0}^{\infty} \gamma^k r_{t+k}$$

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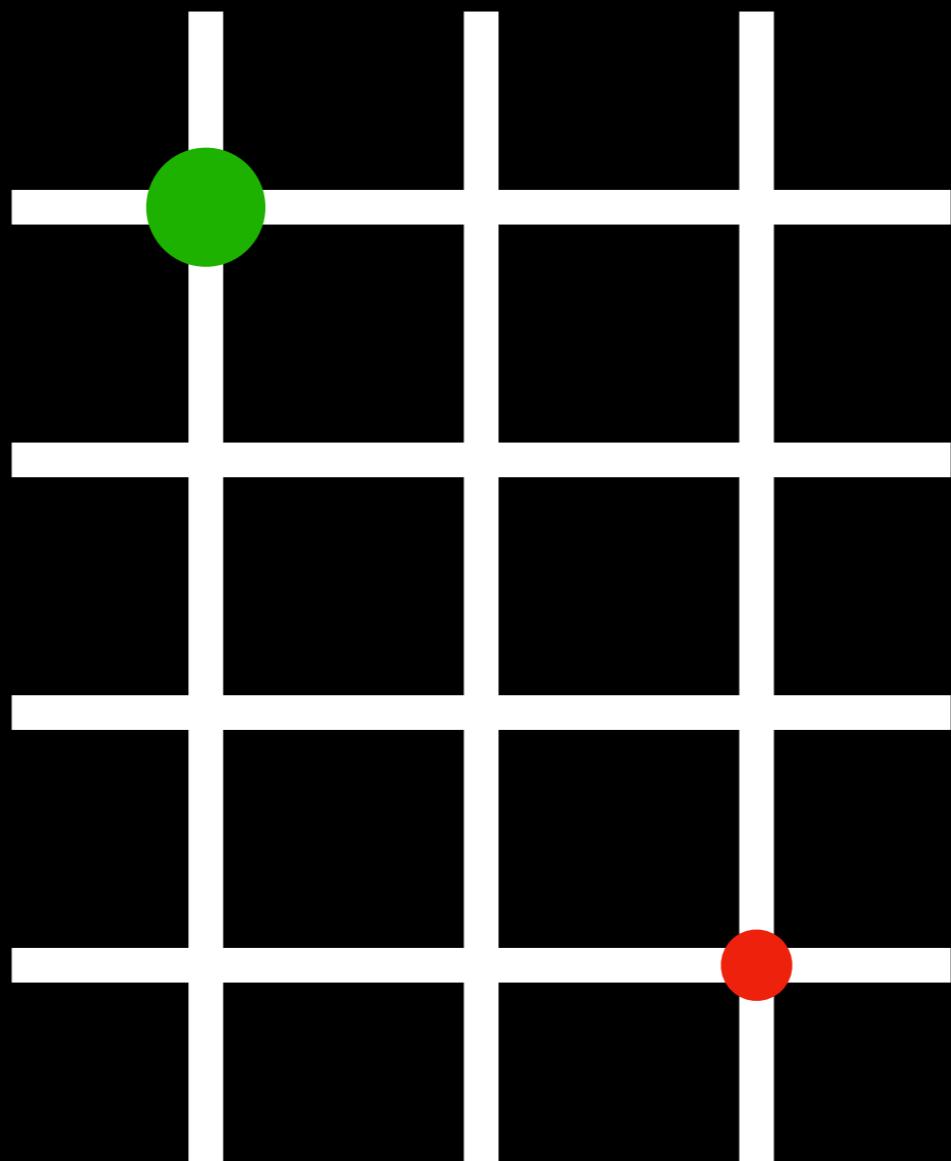
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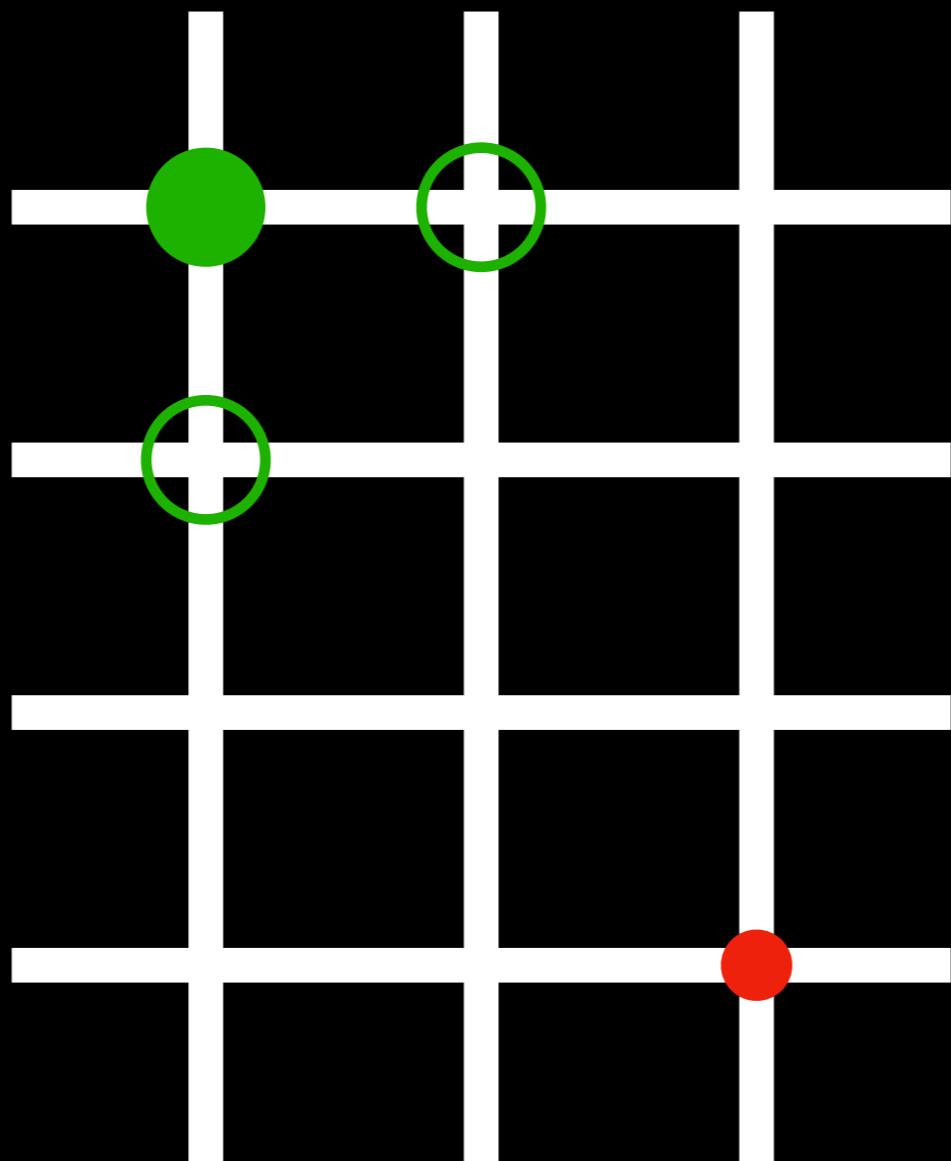
$$Q^\pi(s, a) = E_\pi\{R_t \mid s_t = s, a_t = a\}$$

$$Q(s, a) \leftarrow Q(s, a) + \alpha \left(r_s + \gamma \max_{a'} Q(s', a') - Q(s, a) \right)$$

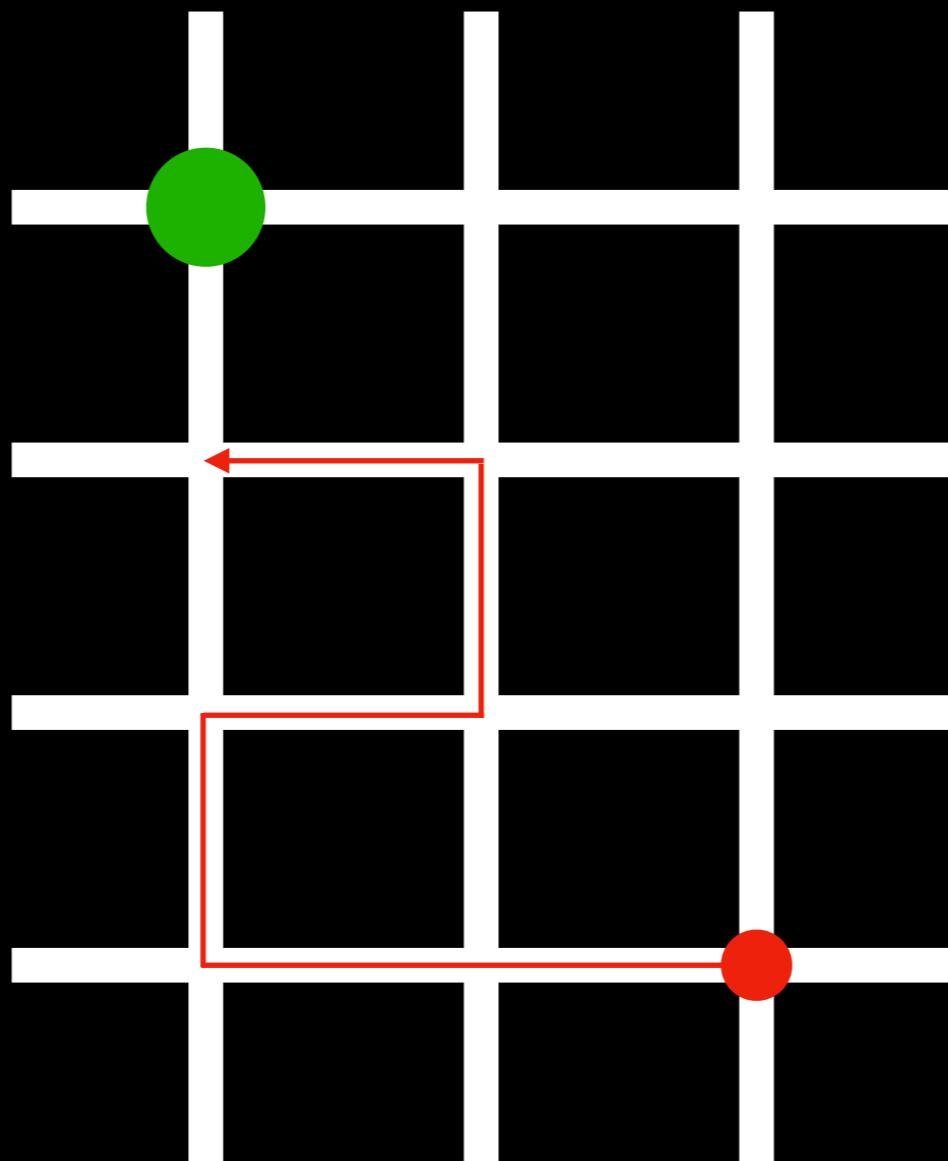
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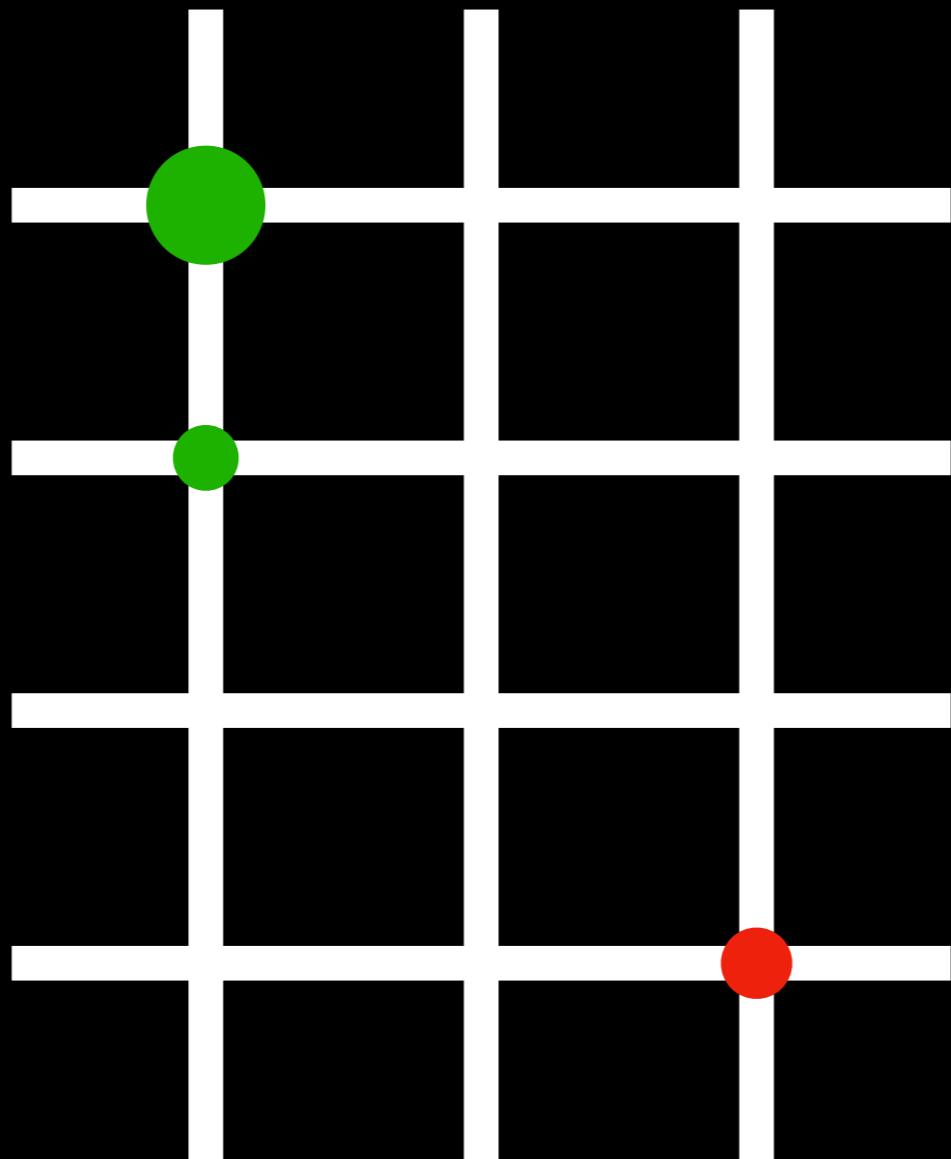


Standard Q-Learning

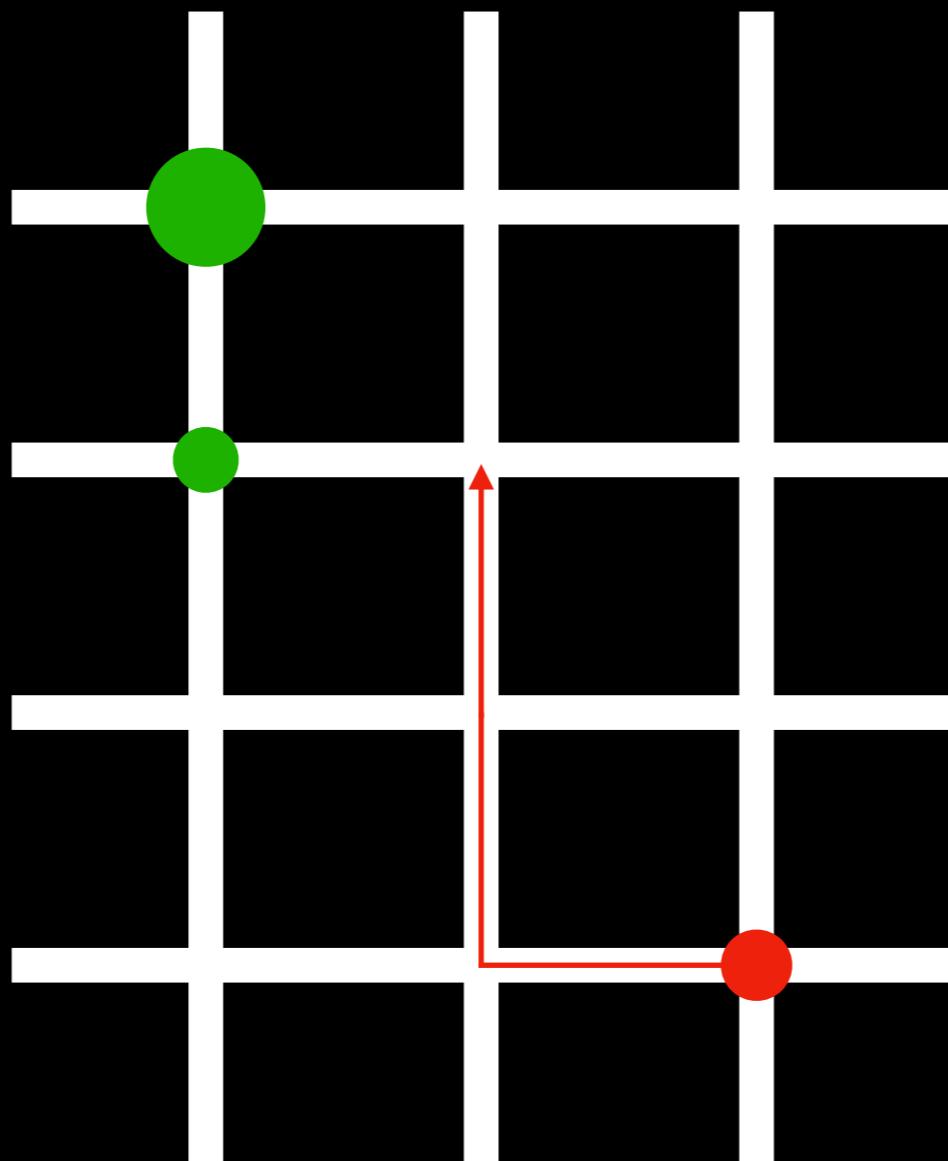
Deep Q-Learning

Cryptocurrency markets

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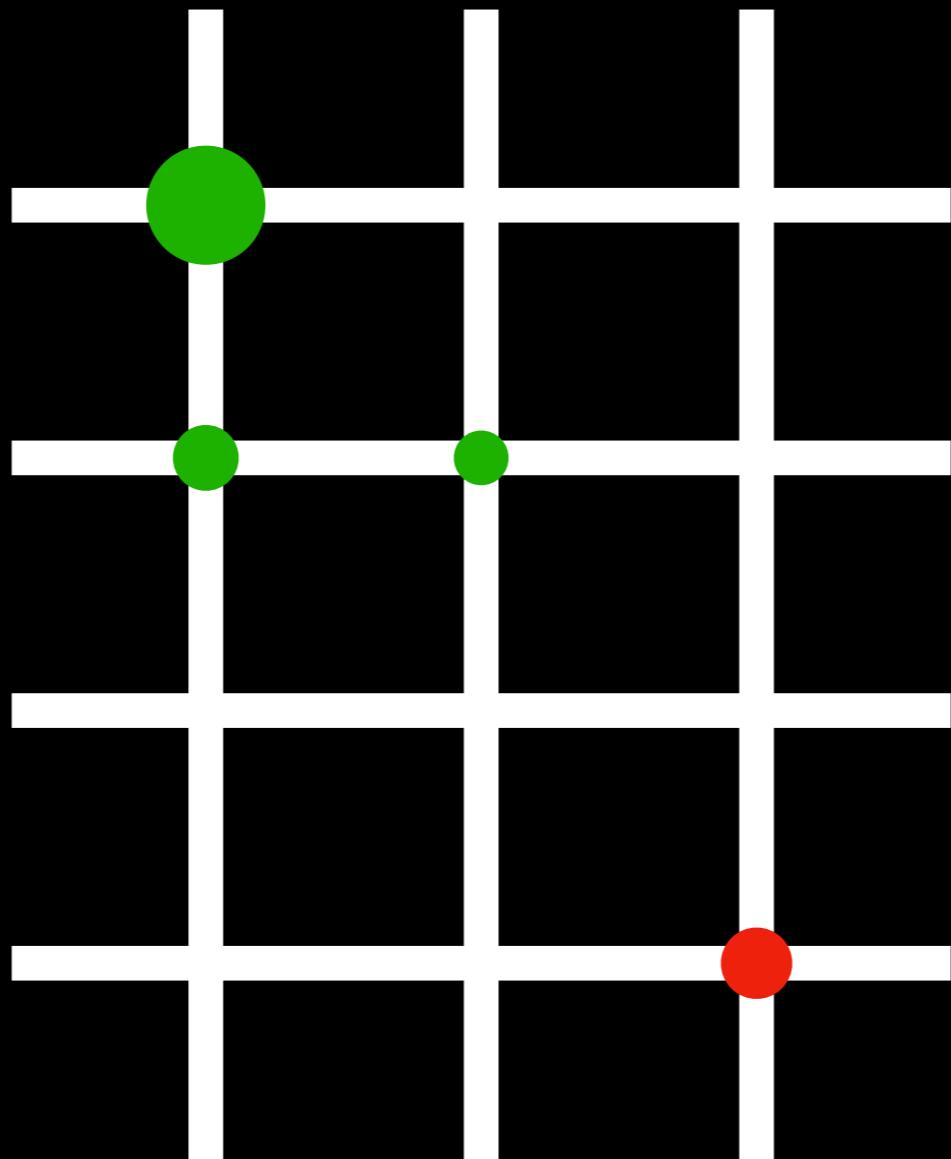


Standard Q-Learning

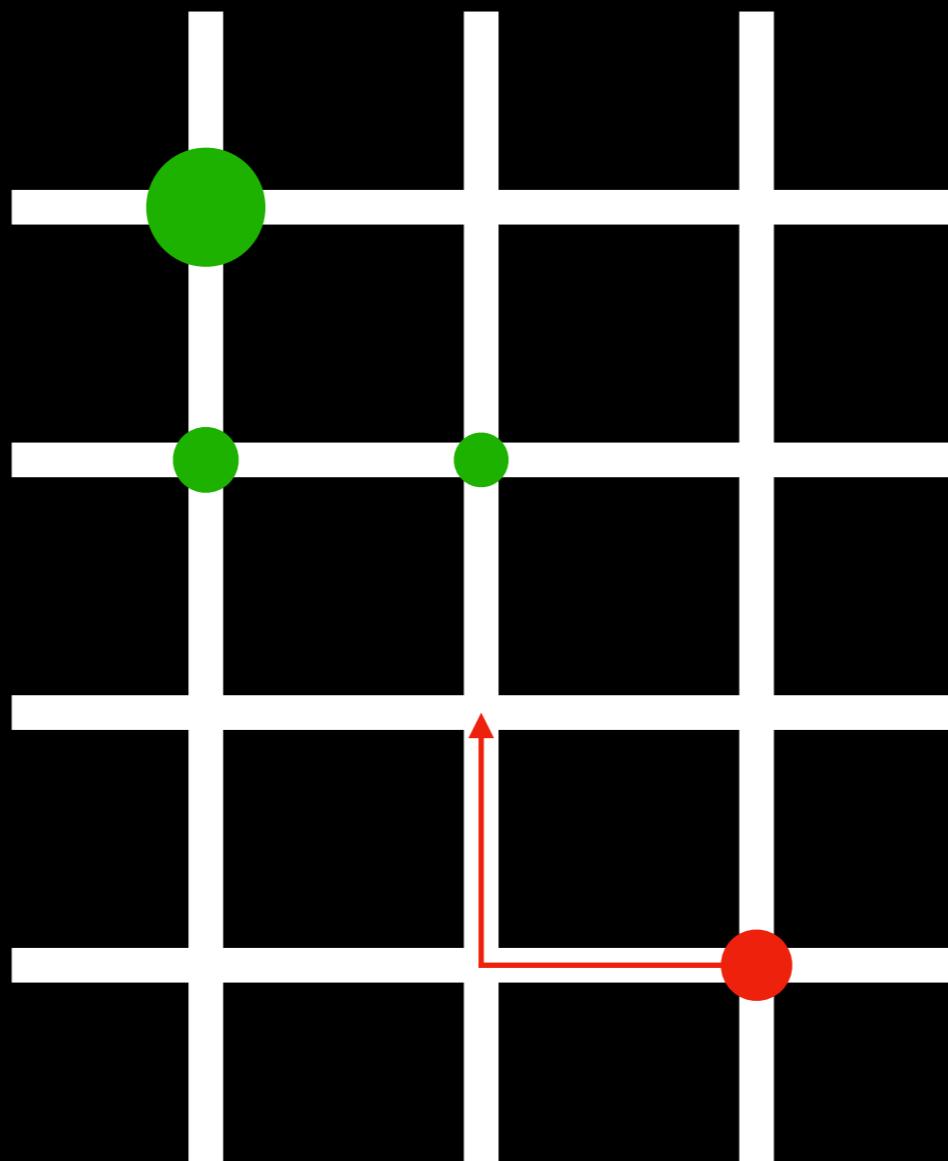
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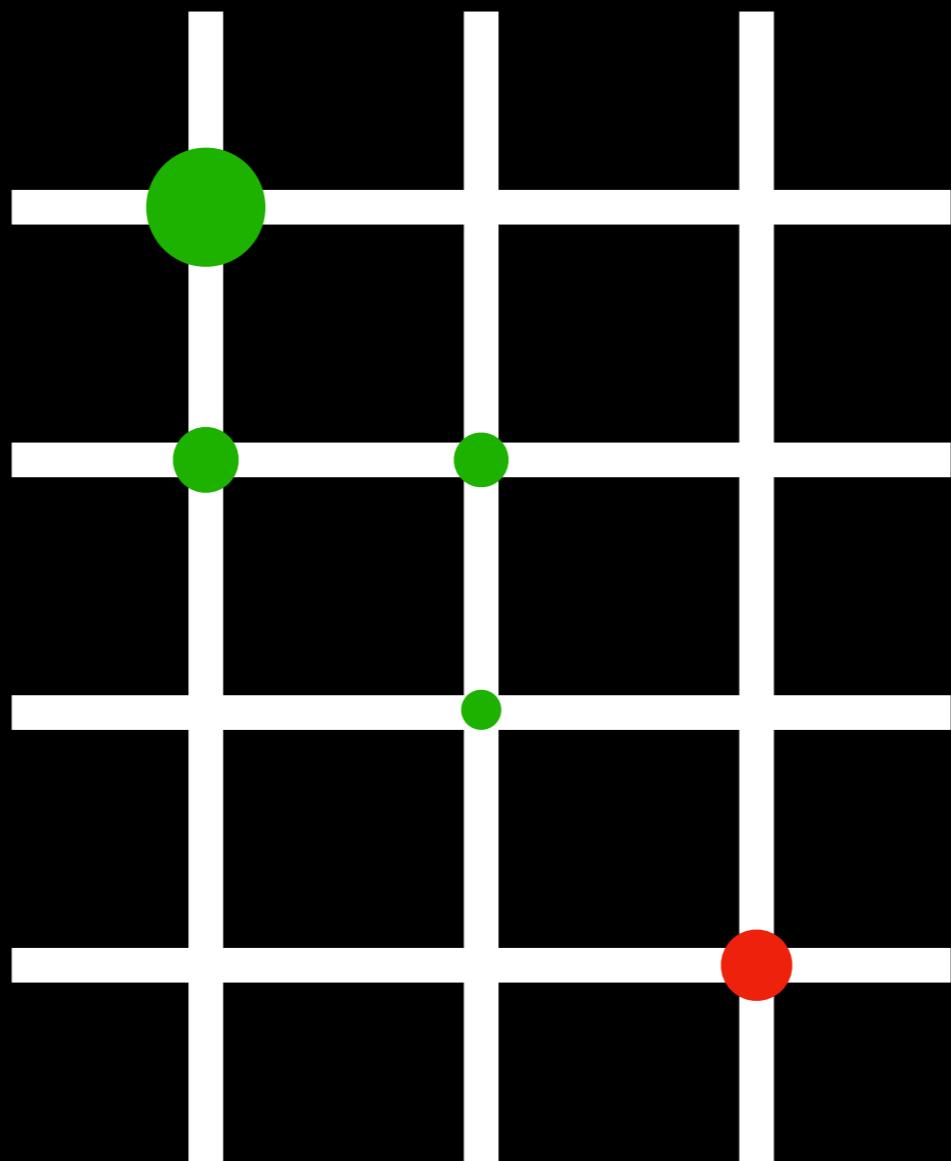


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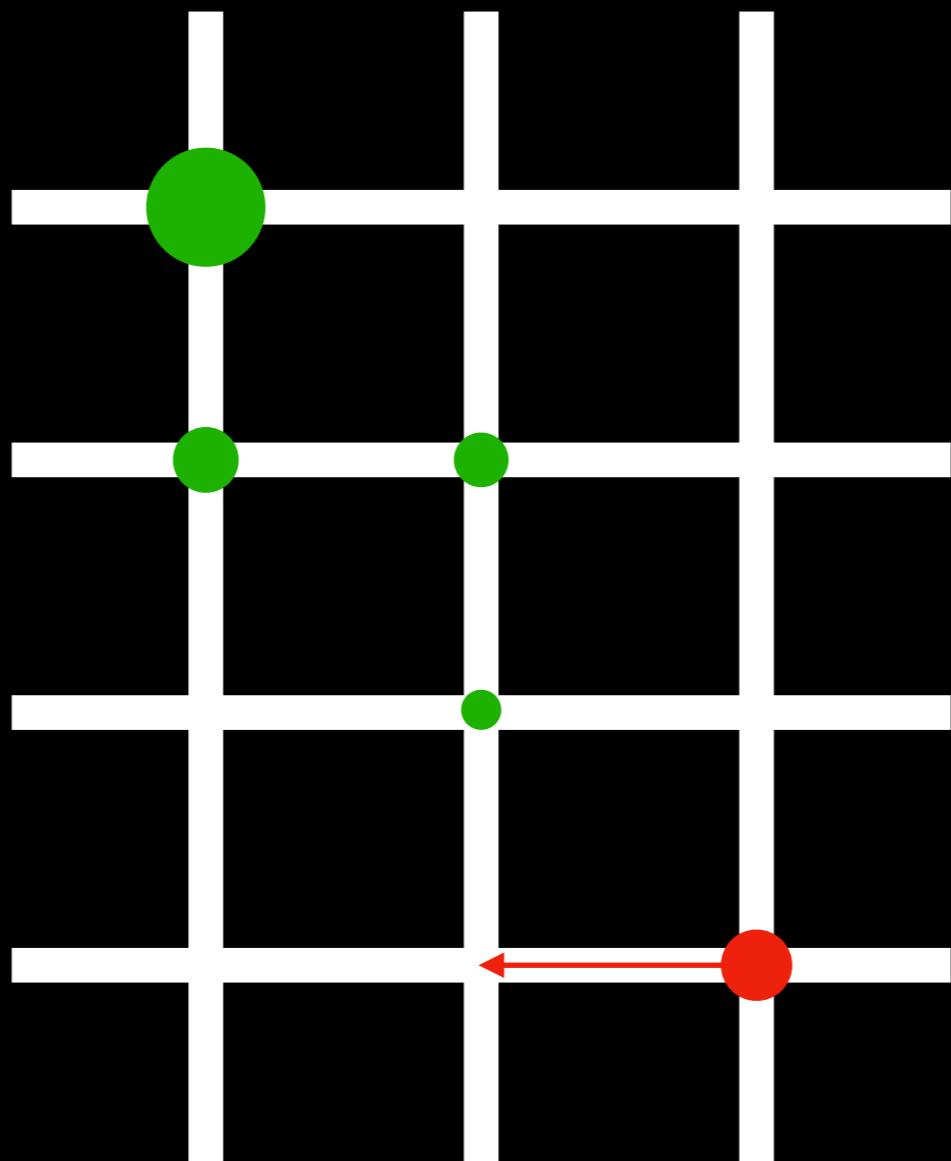
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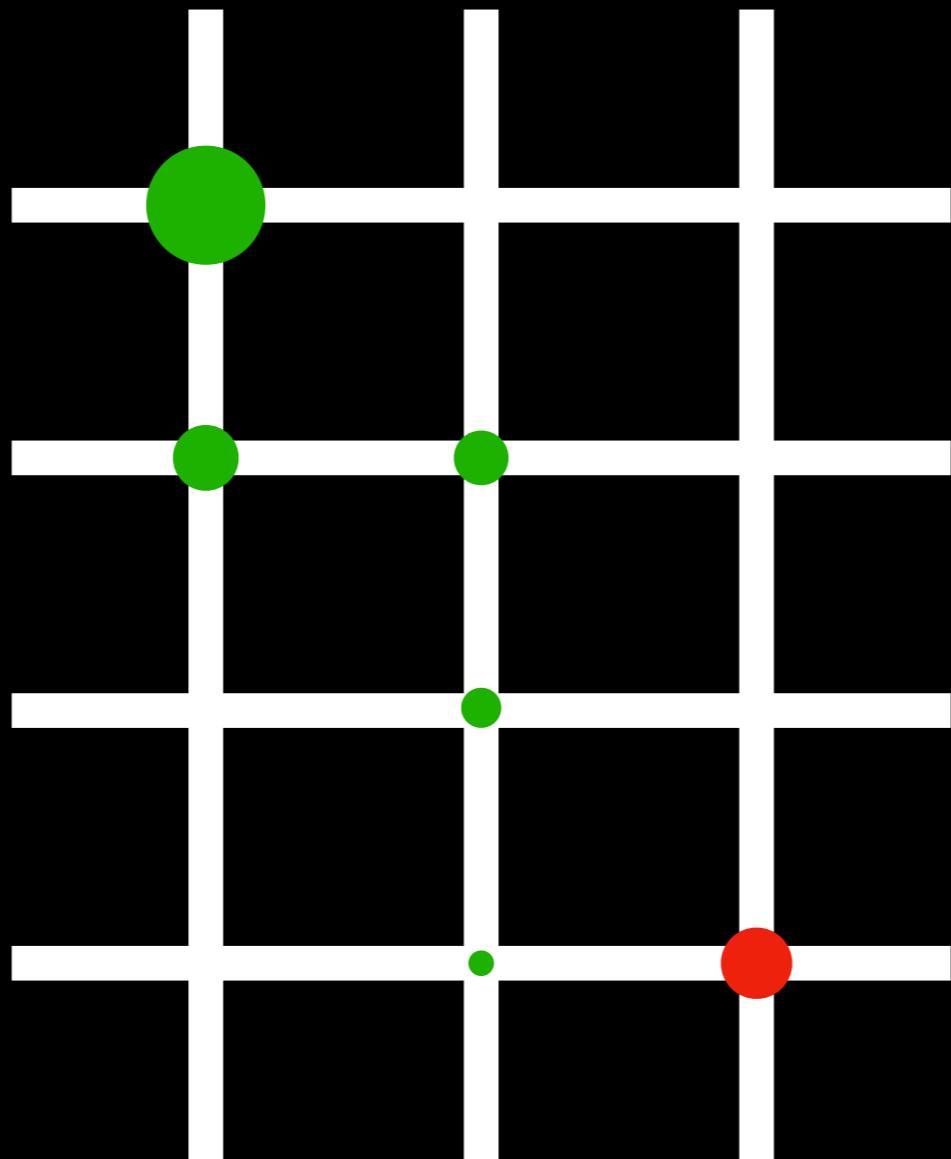


Standard Q-Learning

Deep Q-Learning

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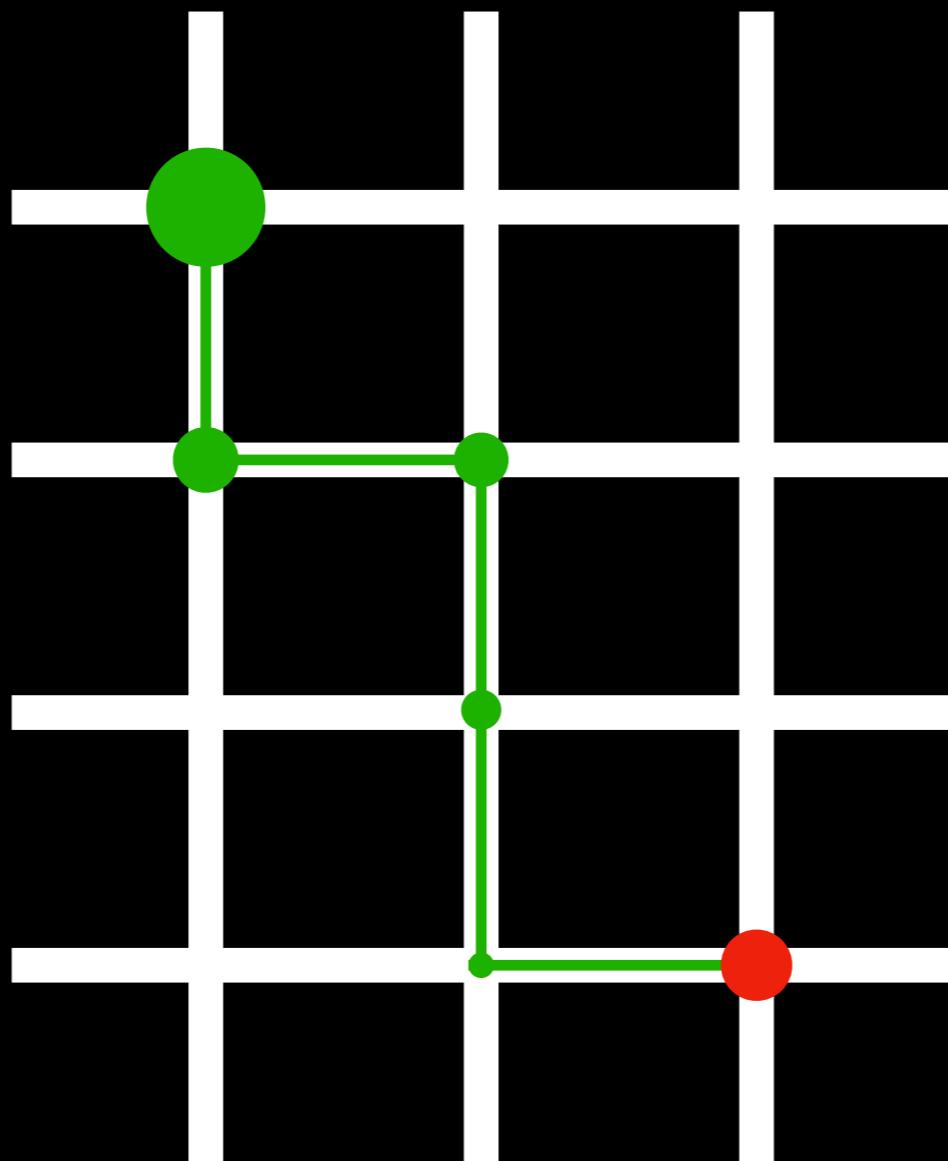


Standard Q-Learning

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Cryptocurrency markets

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Standard Q-Learning

Deep Q-Learning

Cryptocurrency markets

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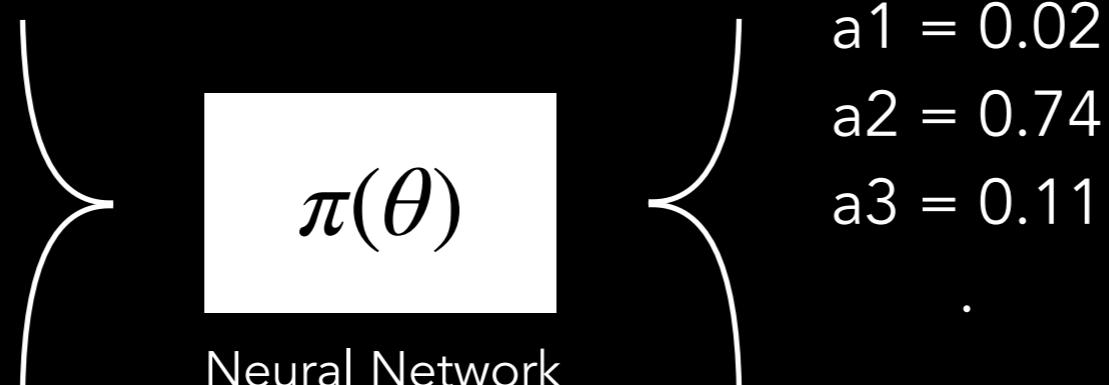
Cryptocurrency markets

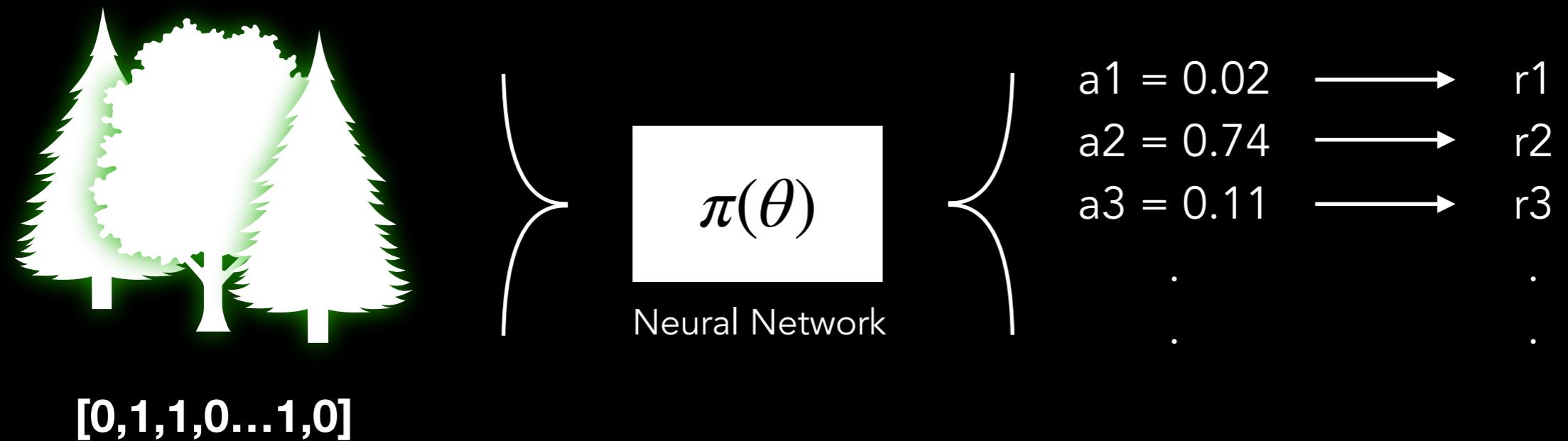


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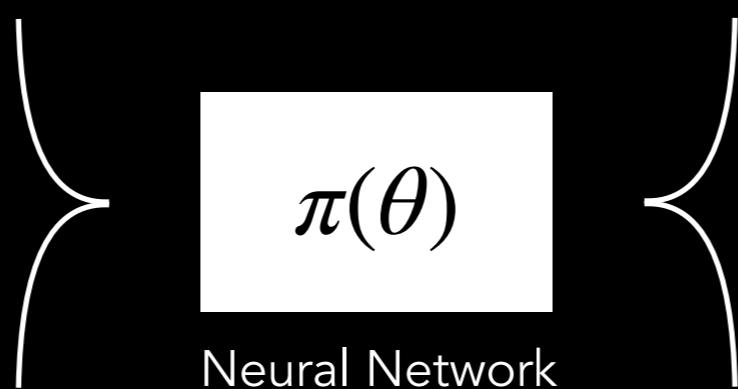


Standard Q-Learning

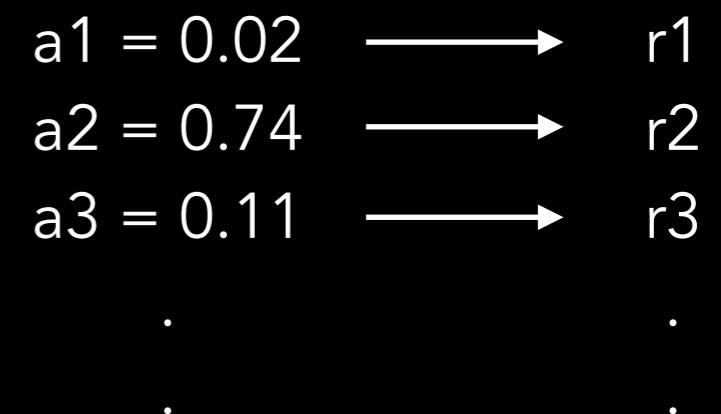


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Deep Q-Learning



Cryptocurrency markets

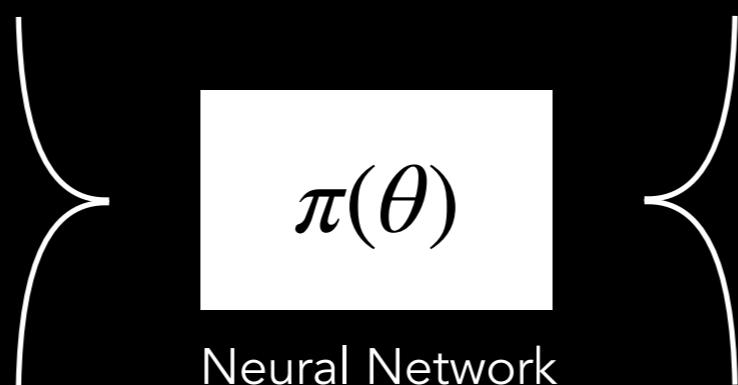


Standard Q-Learning

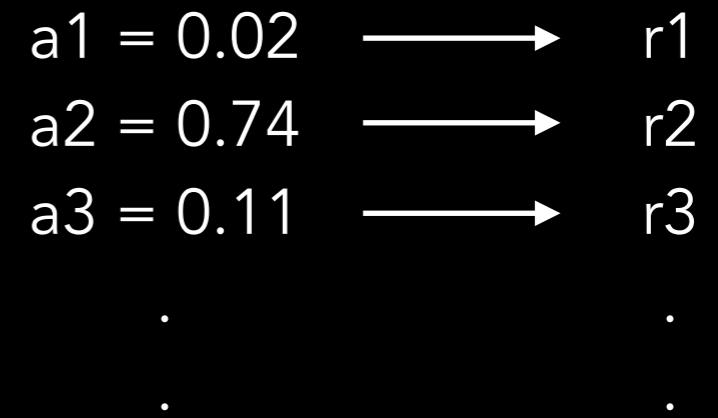


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Deep Q-Learning



Cryptocurrency markets

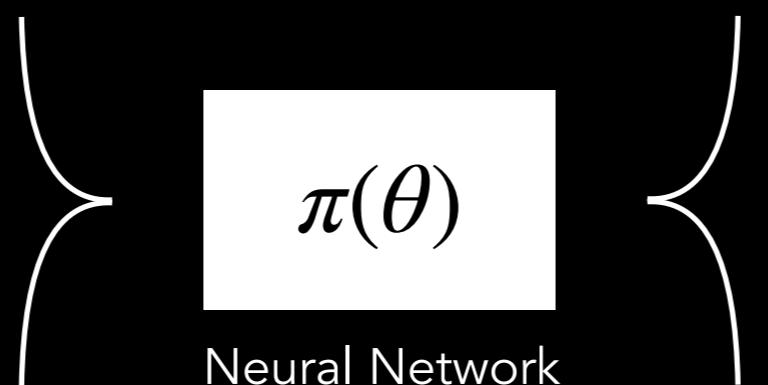


$$\theta \leftarrow \theta + \alpha \left(target_{DQN} - Q(s, a; \theta) \right) \nabla_{\theta} Q(s, a; \theta)$$

Standard Q-Learning



Deep Q-Learning



Cryptocurrency markets

$[0,1,1,0\dots1,0]$

$$\theta \leftarrow \theta + \alpha \left(target_{DQN} - Q(s, a; \theta) \right) \nabla_{\theta} Q(s, a; \theta)$$

$$target_{DQN} = r(s, a, s') + \gamma \max_{a'} T(s', a')$$

Standard Q-Learning

Deep Q-Learning

Cryptocurrency markets

Highly Volatile

Highly Volatile

Low trading fees

Highly Volatile

Low trading fees

Low trading latency

Highly Volatile

Low trading fees

Low trading latency

Large market cap



Highly Volatile



Low trading fees

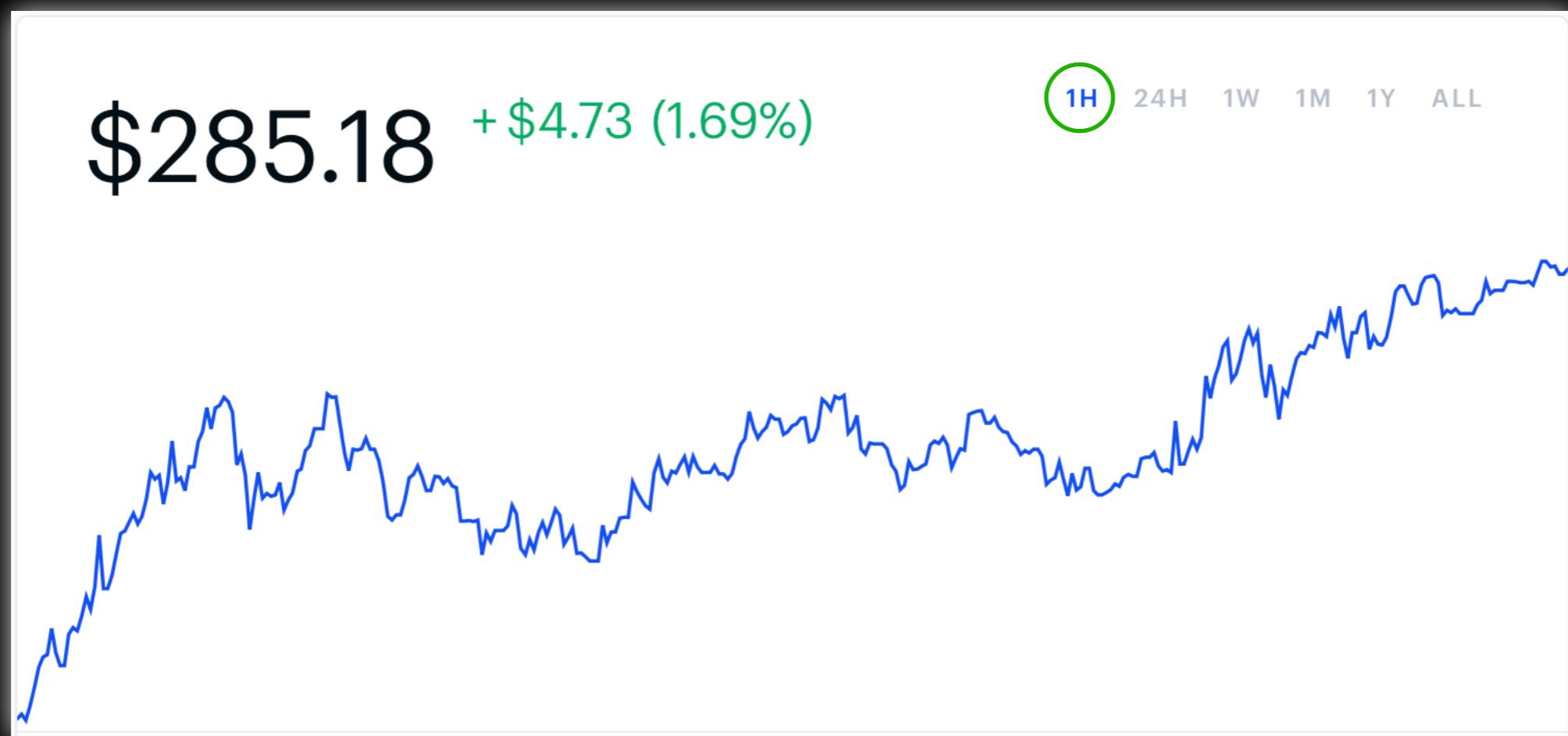


Low trading latency

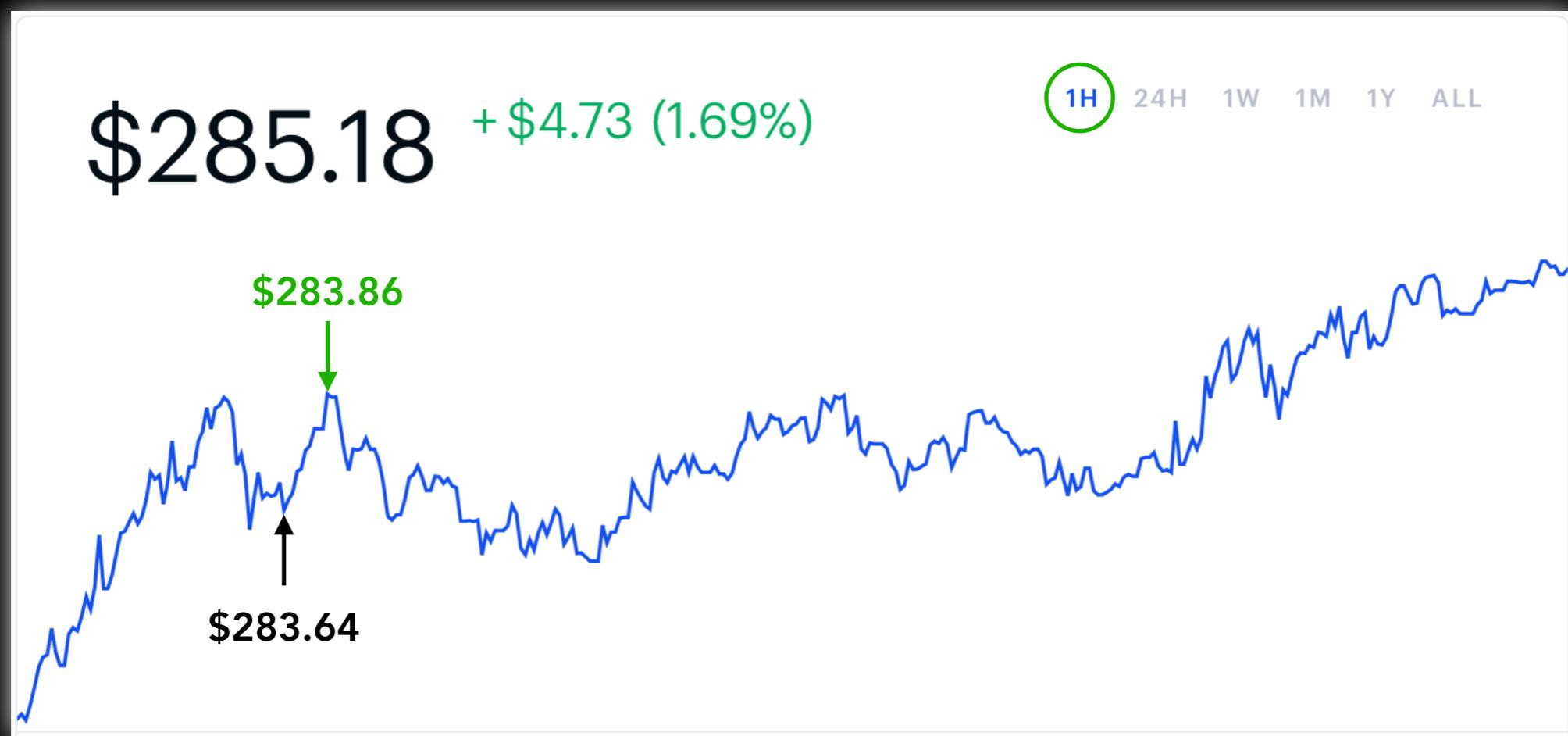


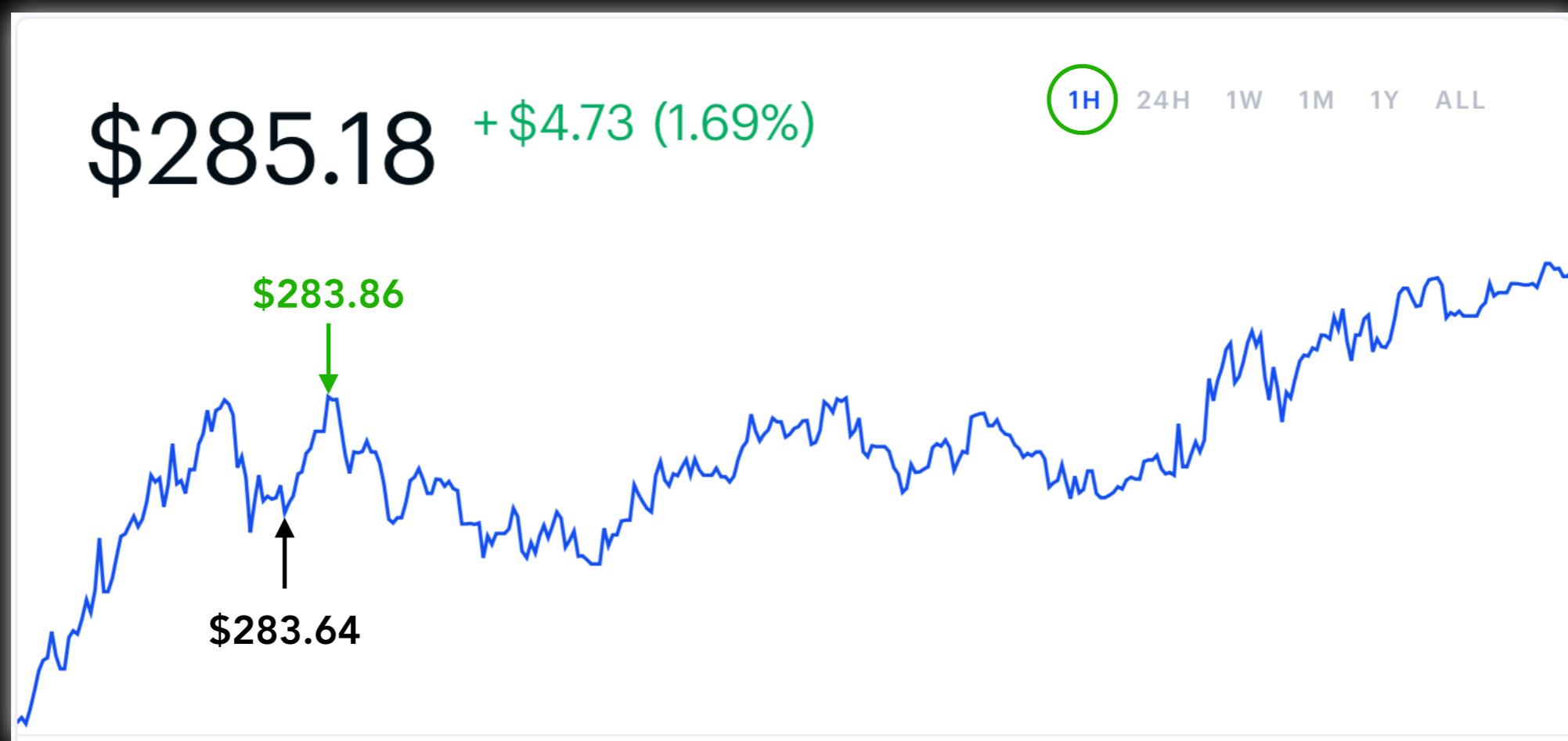
Large market cap

Ethereum



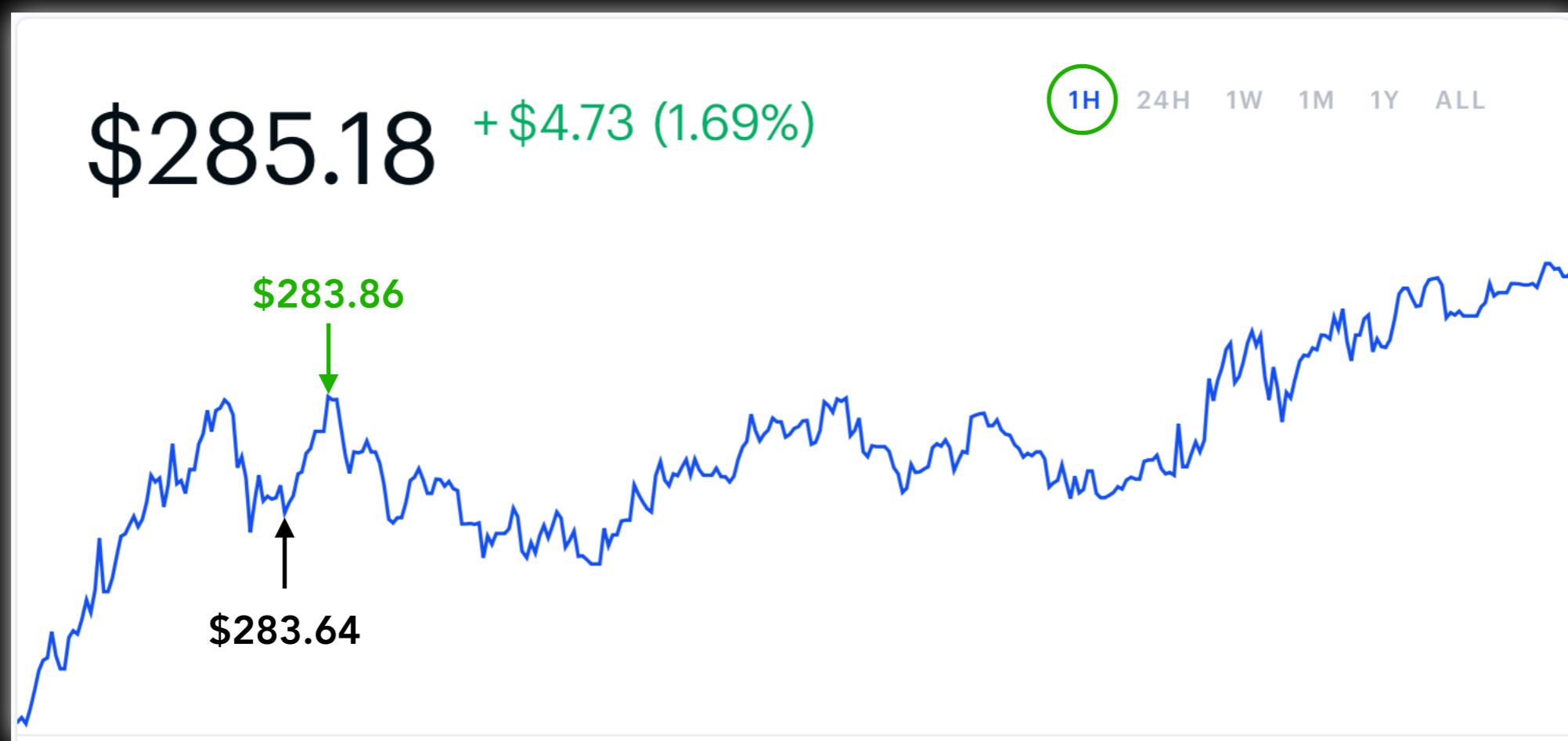
Ethereum



Ethereum

Trade volume: \$1,000.00 USD

Fees: 0.075% per trade

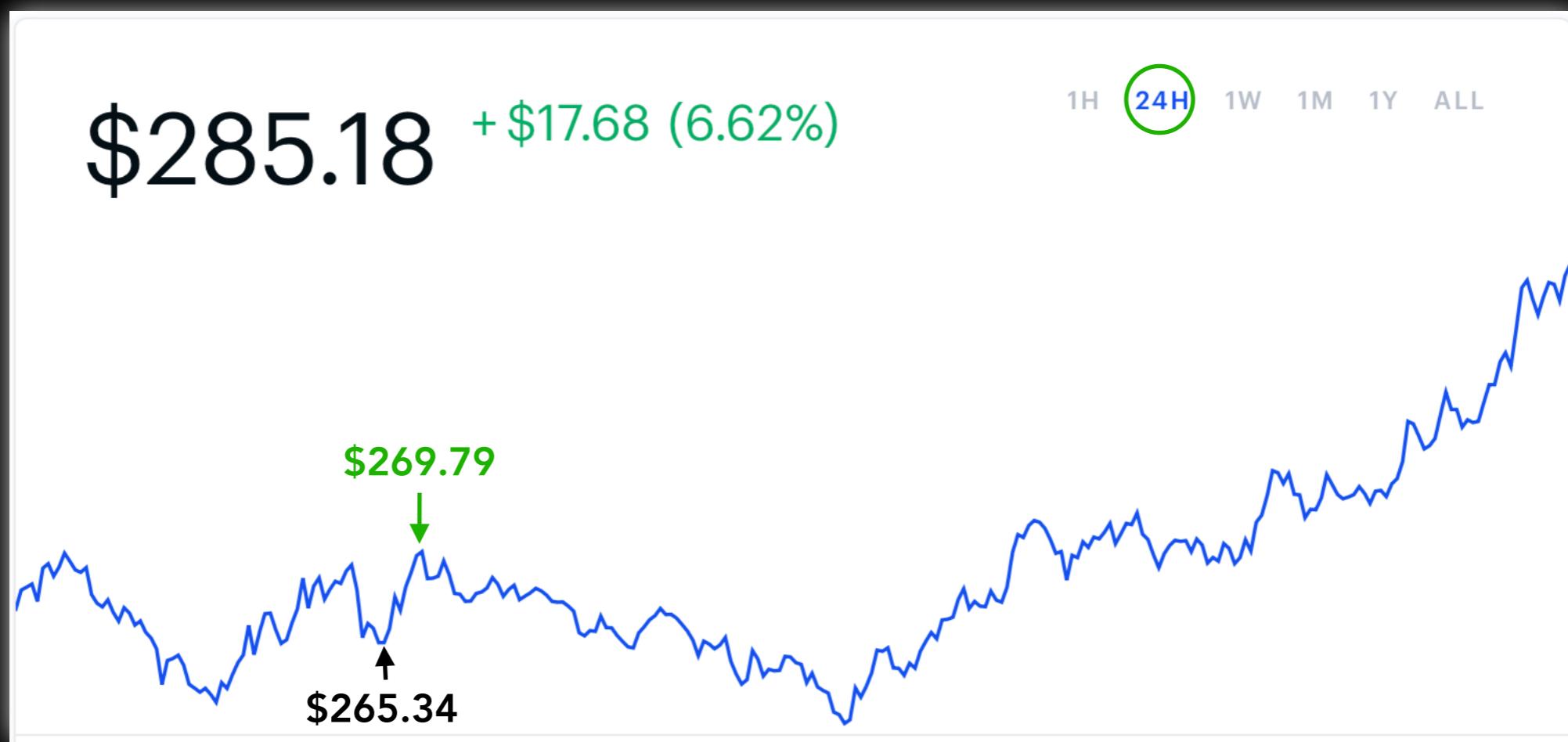
Ethereum

Trade volume: \$1,000.00 USD

Fees: 0.075% per trade

Profit: \$2.81 USD

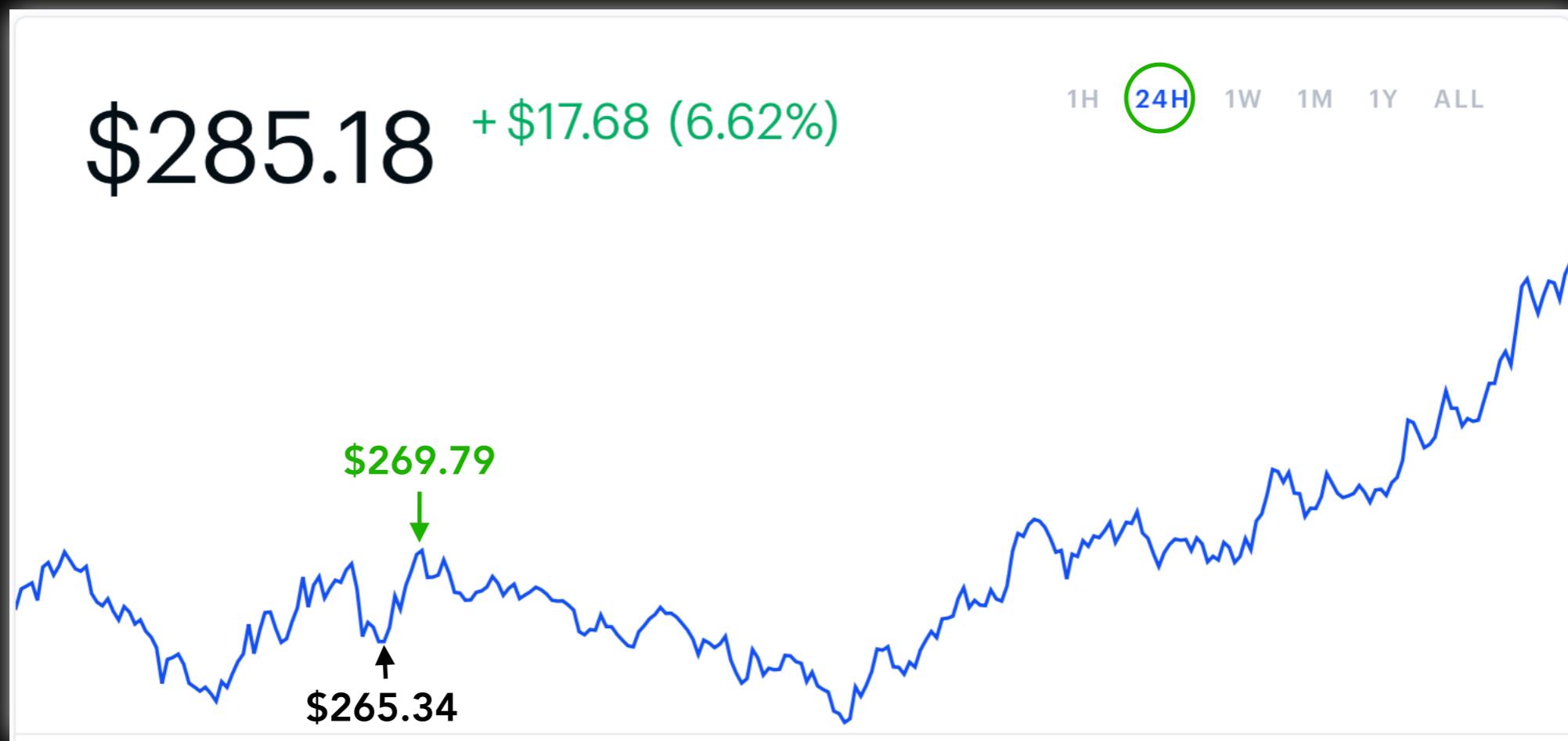
Ethereum



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Fees: 0.075% per trade

Ethereum



Trade volume: \$1,000.00 USD

Fees: 0.075% per trade

Profit: \$15.25 USD