Hi

school of ai Algiers

Deep Reinforcement Learning

Deep Q-Network

Azzeddine CHENINE
@azzeddineCH_

AI EVERYTIME EVERYWHERE

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OpenAI

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Quick Reminder

Q-Learning

Quick Reminder

Learning by experience

Quick Reminder

Learning by experience

Episodic tasks and continuous task

Quick Reminder

Learning by experience

Episodic tasks and continuous task

An action has a reward and results a new state

Quick Reminder

The value based methods try to reach an optimal policy by using a value function

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The Q function of an optima policy maximise the expected return G

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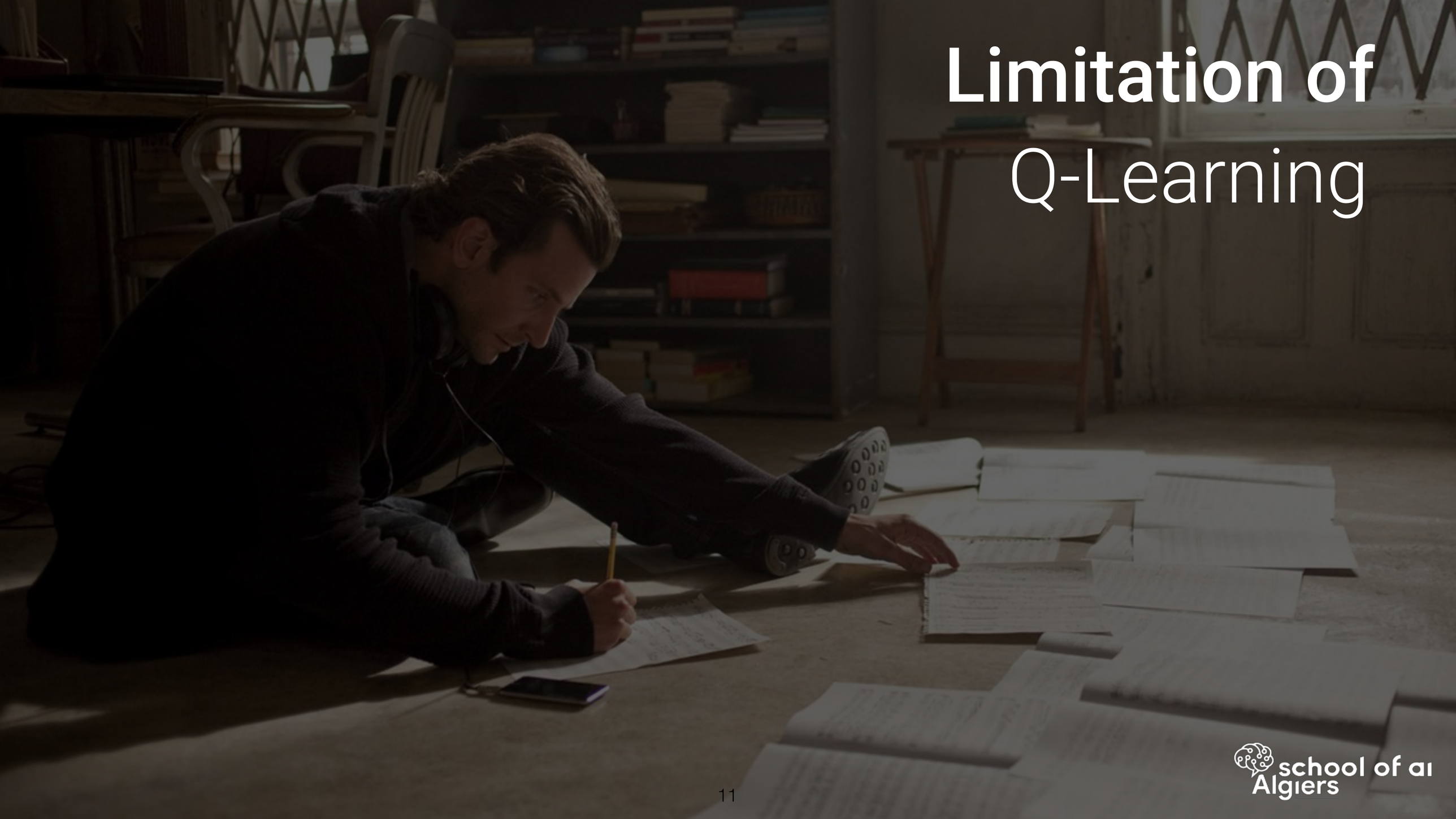
Epsilon greedy policies solve the exploration and exploitation problem



Limitation of Q-Learning

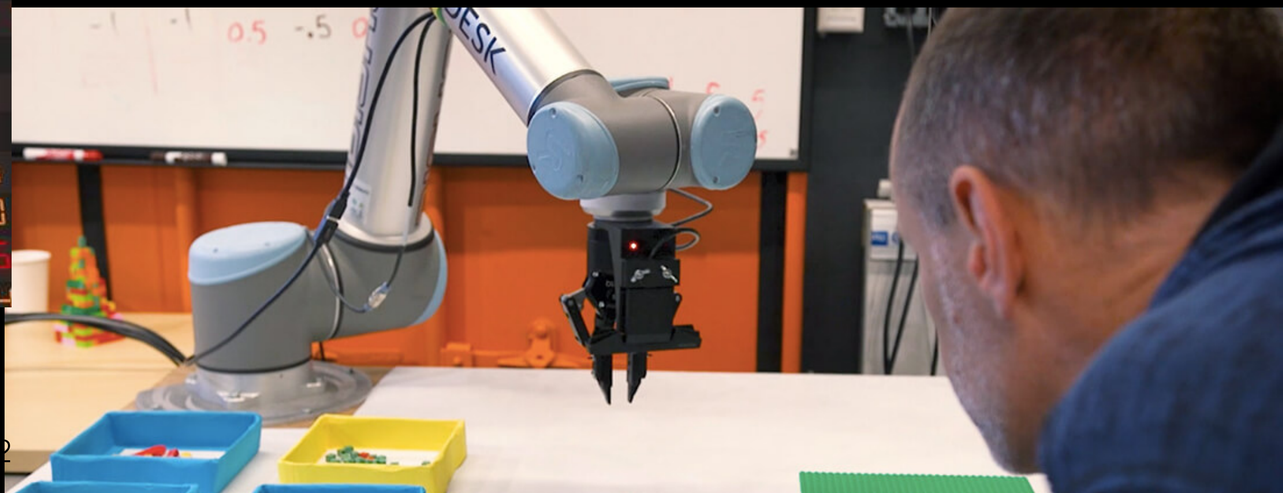
Limitation

Non practical with environments with large or infinite state or action space

Games

Stock market

Robots



Modern problems
require
Modern solutions

Deep Q-Networks

Deepminds

- 2015 -

No more given definitions ….

No more given definitions ….

figuring it out by ourselves

Neural networks can be trained to fit on a linear or a non linear function.

1 - How to replace the Q-table ?

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Replace the Q-value function with a deep neural network

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The outputs layer hold the Q-value of each possible action

$\Longrightarrow$ **make the actions space discrete**

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Replace the Q-value function with a deep neural network

The outputs layer hold the Q-value of each possible action

$\Longrightarrow$ **make the actions space discrete**

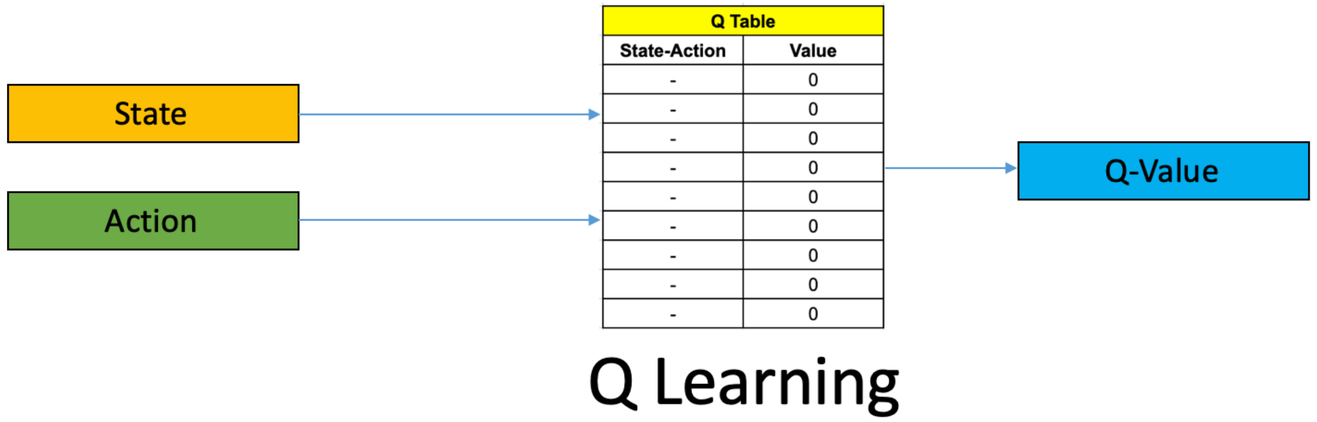
The input layer takes the desired representation of the state

$\Longrightarrow$ **a pipeline of convolutions**

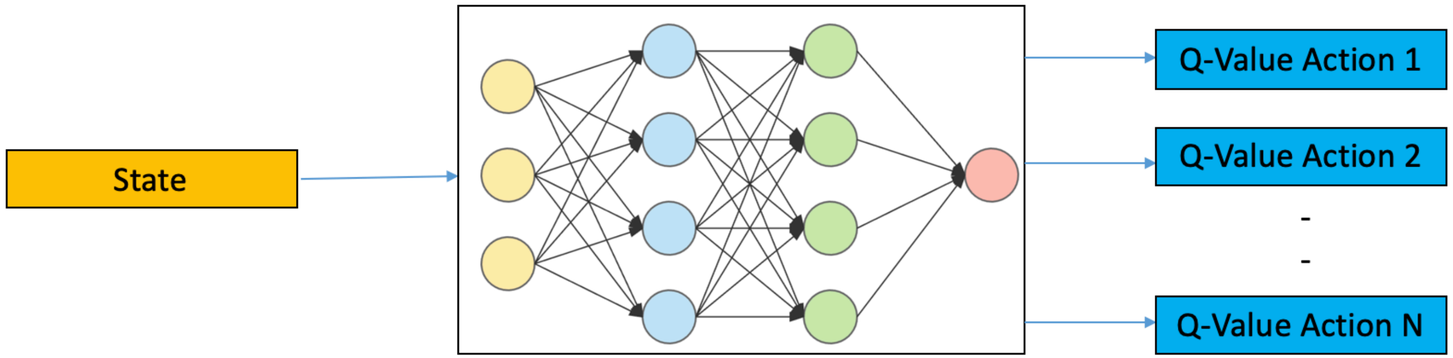
$\Longrightarrow$ **a Dense layer**

$\Longrightarrow$ **a sequence of LSTM/RNN cells**

1 - How to replace the Q-table ✅



Q Learning



Deep Q Learning

How did we used update the Q-table

The agent took an action (a) in a state (S)

1 - How to replace the Q-table ✅

2 - How to optimize the model

How did we used update the Q-table

The agent took an action (a) in a state (S)

The agent moved to the next state (S’) and received a reward (r)

1 - How to replace the Q-table ✅

2 - How to optimize the model

How did we used update the Q-table

The agent took an action (a) in a state (S)

The agent moved to the next state (S') and received a reward (r)

the discount rate δ reflects how much we care about the futur reward

$\delta \approx 1 \Longrightarrow$ we care too much about the future reward

$\delta \approx 0 \Longrightarrow$ we care too much about the immediate reward

1 - How to replace the Q-table ✅

2 - How to optimize the model

How did we used update the Q-table

$$Q'(S, a) \Longleftarrow Q(S, a) + \alpha\,[\,r(S, a, S') + \delta \max Q(S', a') - Q(S, a)\,]$$

A good **Q** value for an action (a) given a state (S) is a good approximation to the expected discounted cumulative reward.

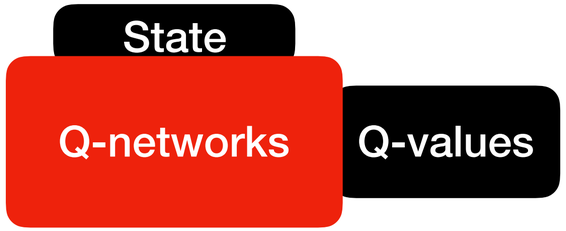
$$\Longrightarrow Q(S, a) \approx r(S, a, S') + \delta \max Q(S', a')$$

1 - How to replace the Q-table ✅

2 - How to optimize the model

How are we going to update the Q-networks weights

$$\Longrightarrow Q(S, a) \approx r(S, a, S') + \delta \max Q(S', a')$$



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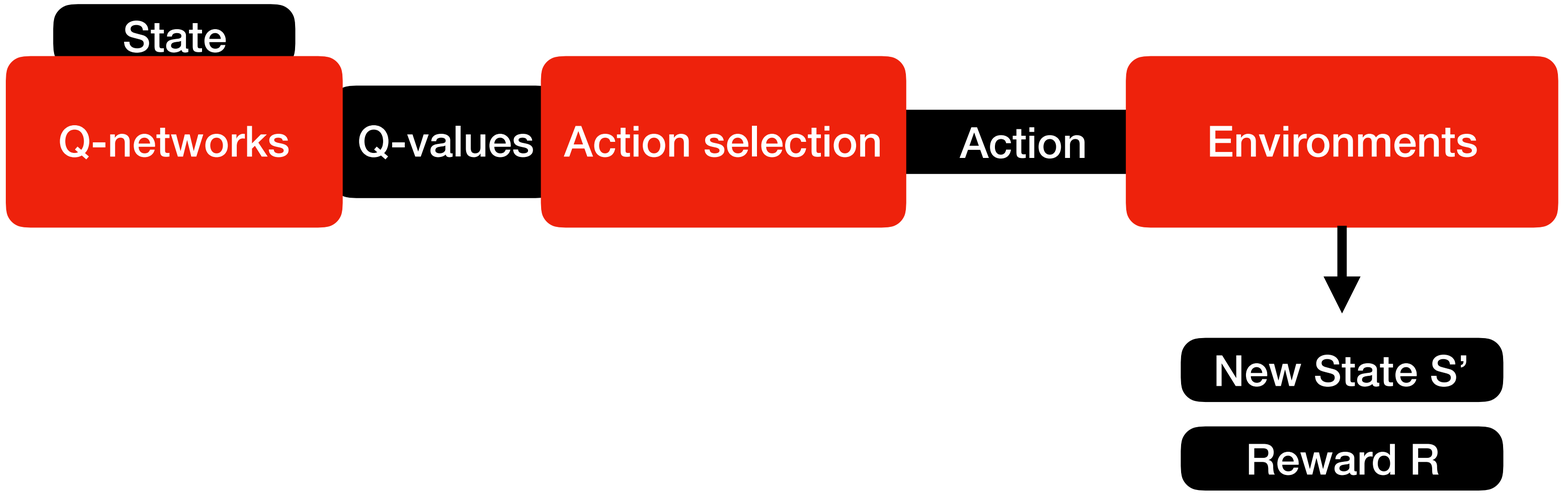

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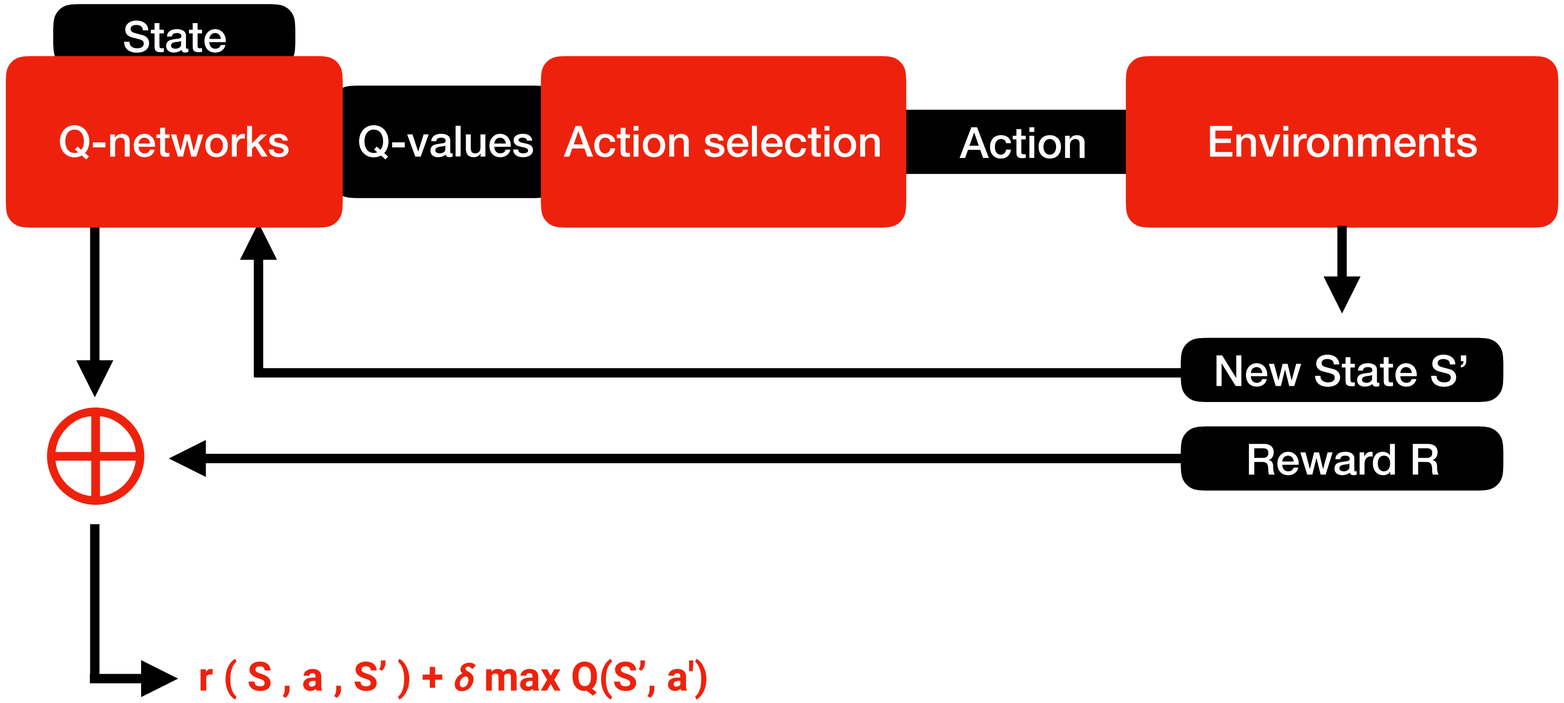

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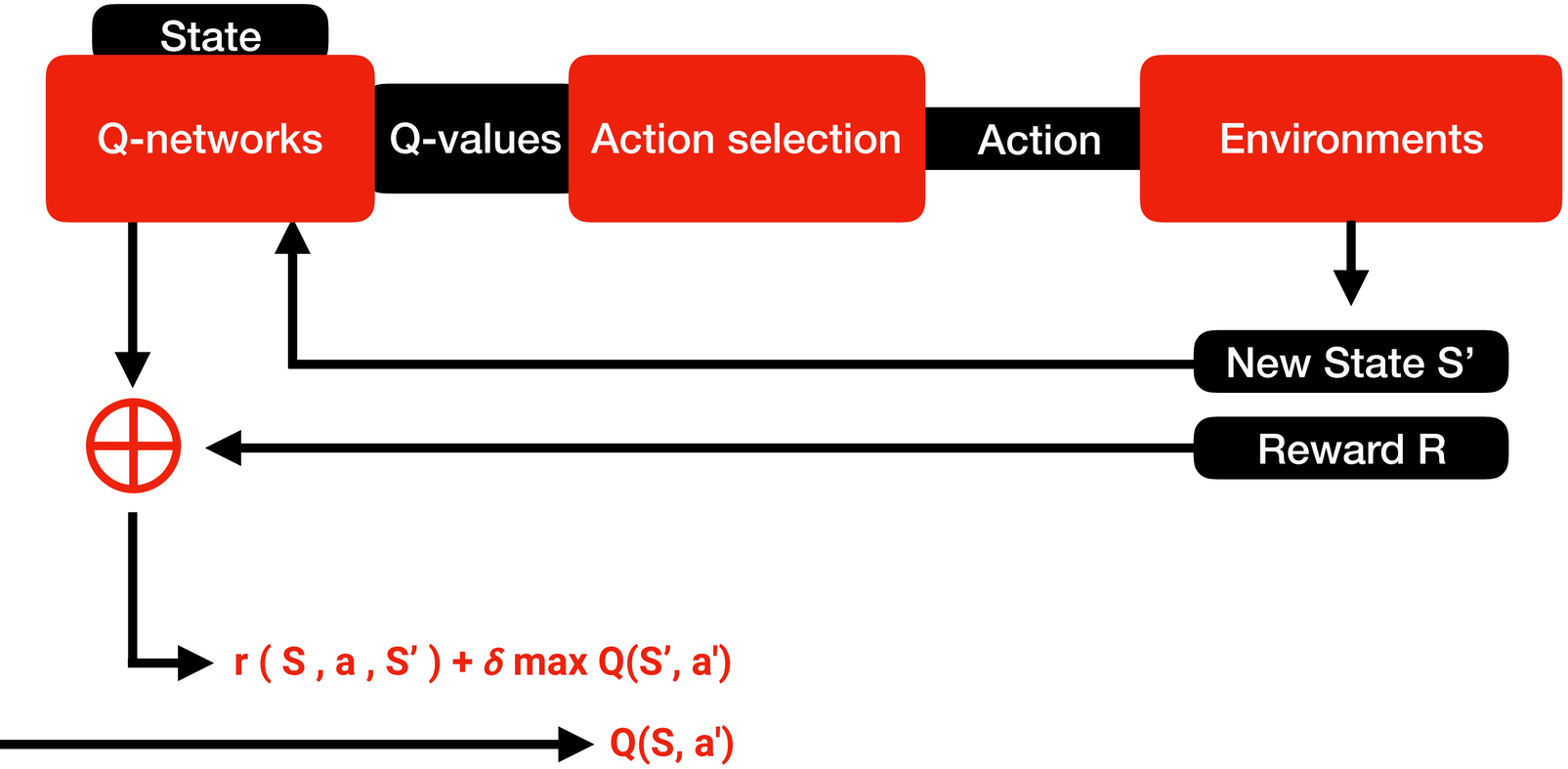

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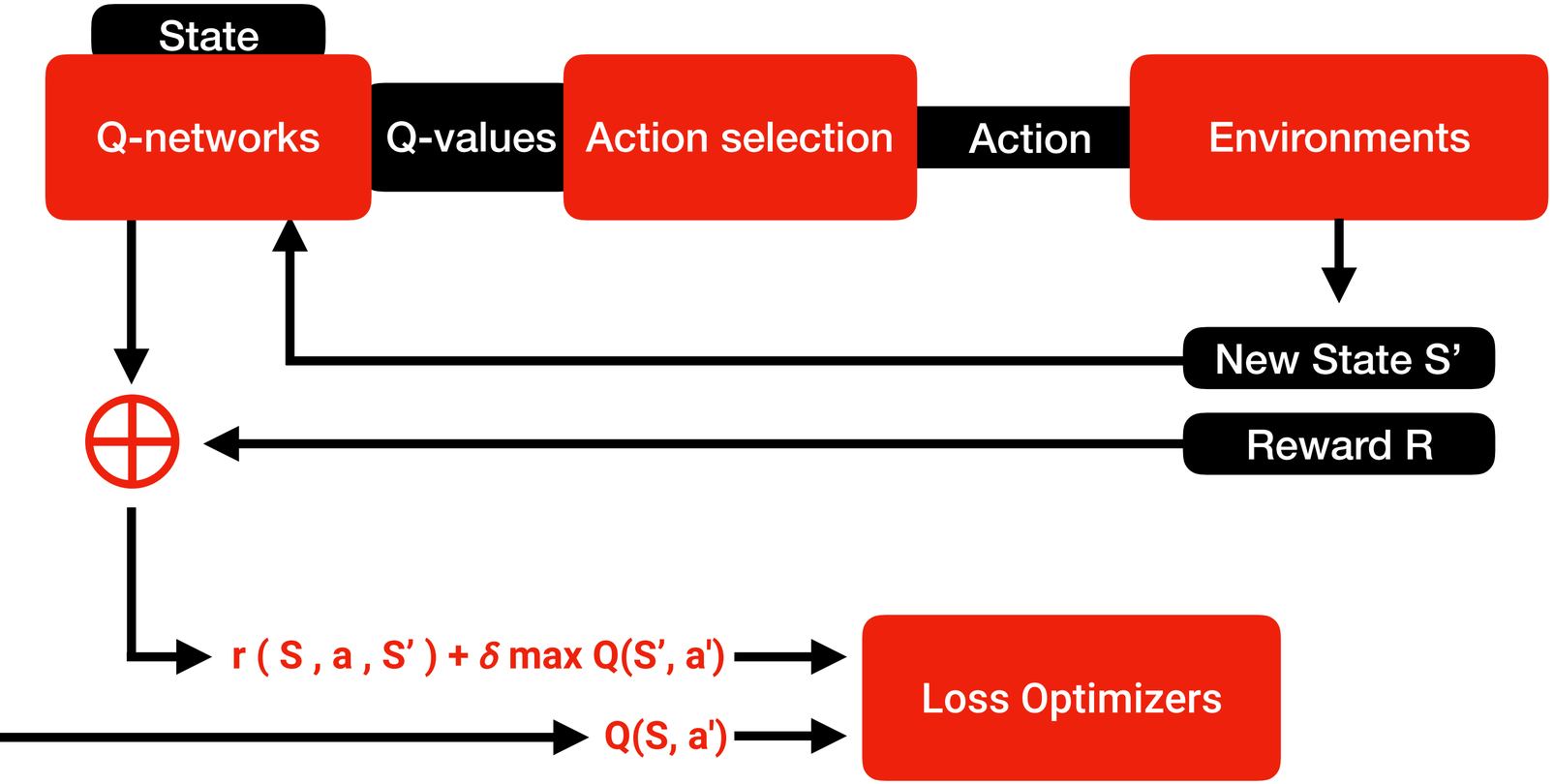

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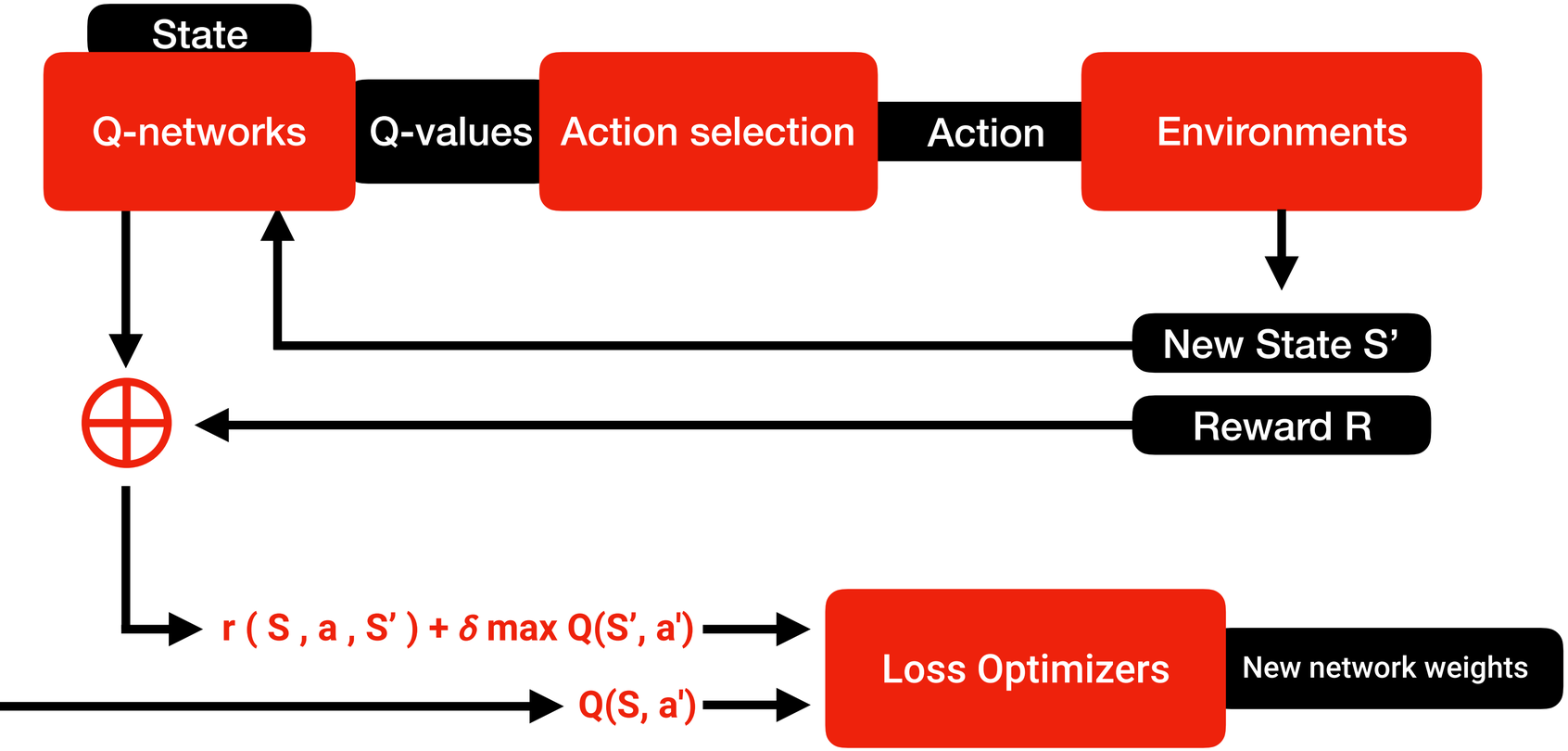

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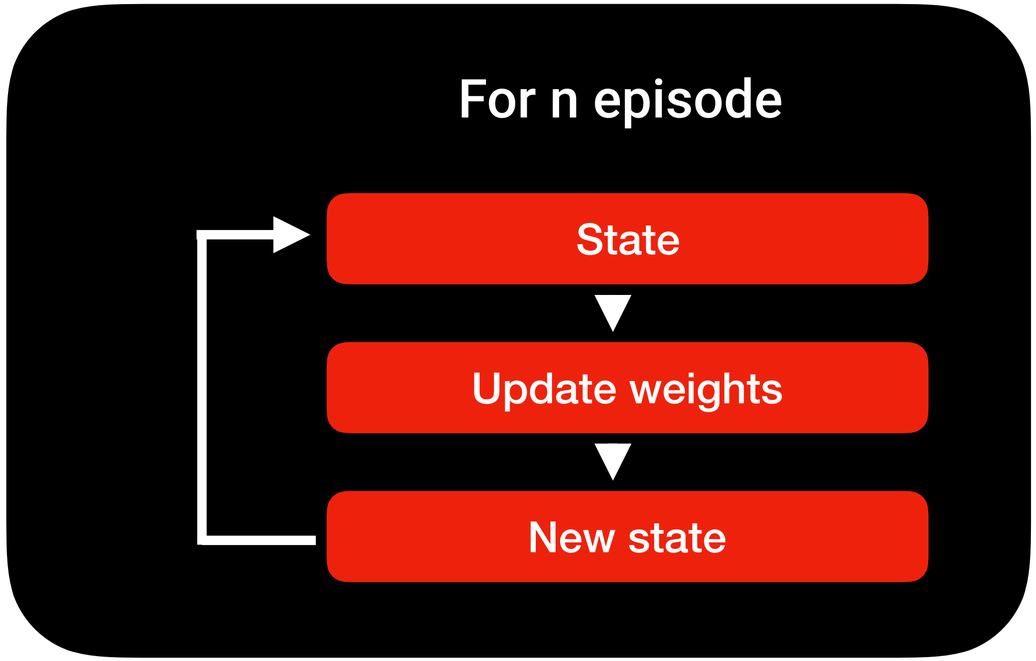


1 - How to replace the Q-table ✅

2 - How to optimize the model

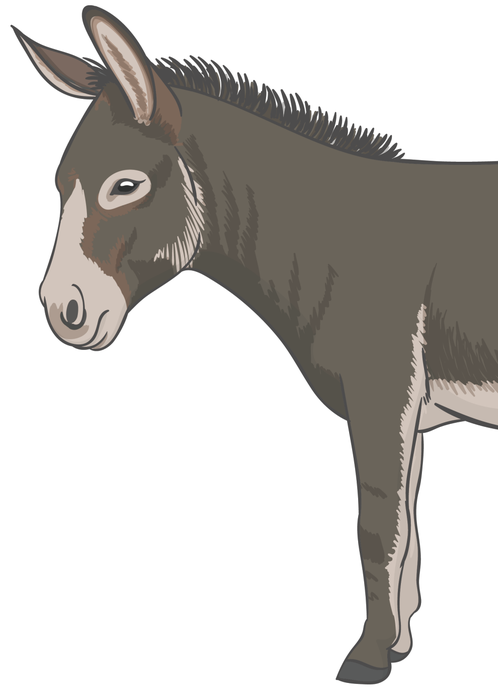
We are chasing a moving target

$r(S, a, S') + \delta \max Q(S', a')$

$Q(S, a)$

$$r(S, a, S') + \delta \max Q(S', a')$$

$$Q(S, a)$$



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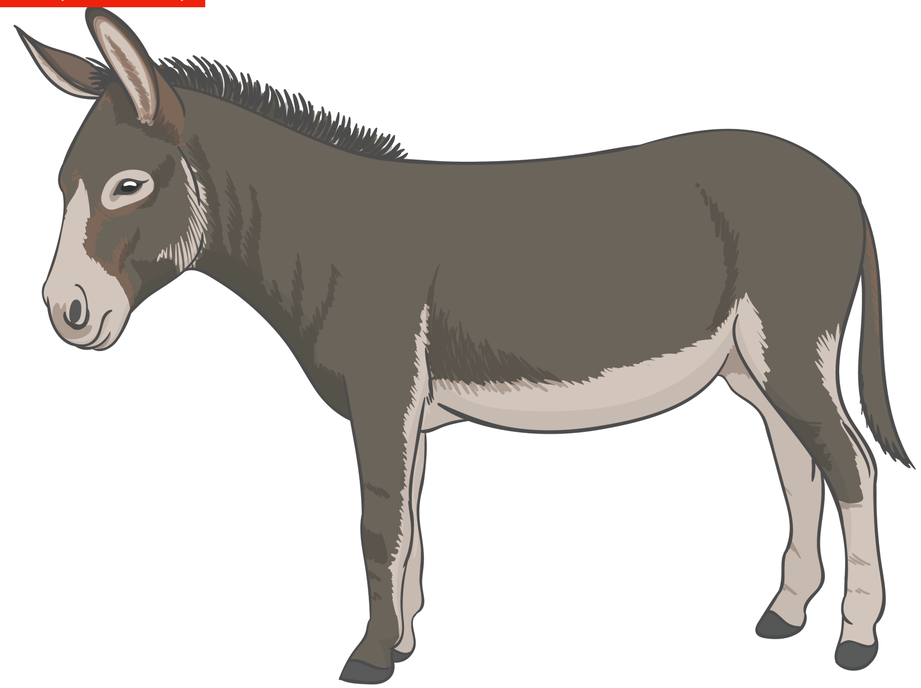

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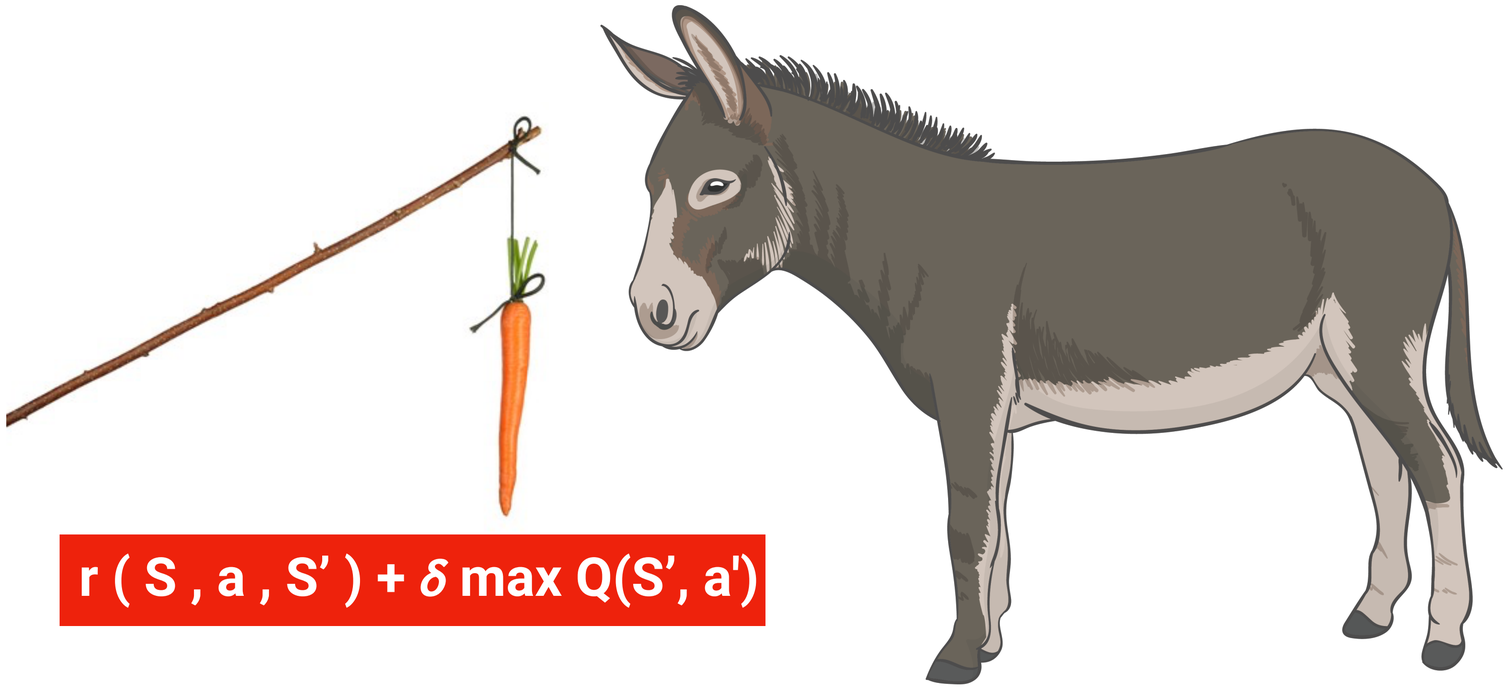

$$r(S, a, S') + \delta \max Q(S', a')$$

How are we going to update the Q-networks weights

We use a local network and a target network

1 - How to replace the Q-table ✅

2 - How to optimize the model ✅

3 - T-target

How are we going to update the Q-networks weights

We use a local network and a target network

The target neural network get slightly updated based on the local networks weights

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The target neural network get slightly updated based on the local networks weights

The local network predict the Q-values for the current state

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How are we going to update the Q-networks weights

We use a local network and a target network

The target neural network get slightly updated based on the local networks weights

The local network predict the Q-values for the current state

The target network predict the Q-values for the next state

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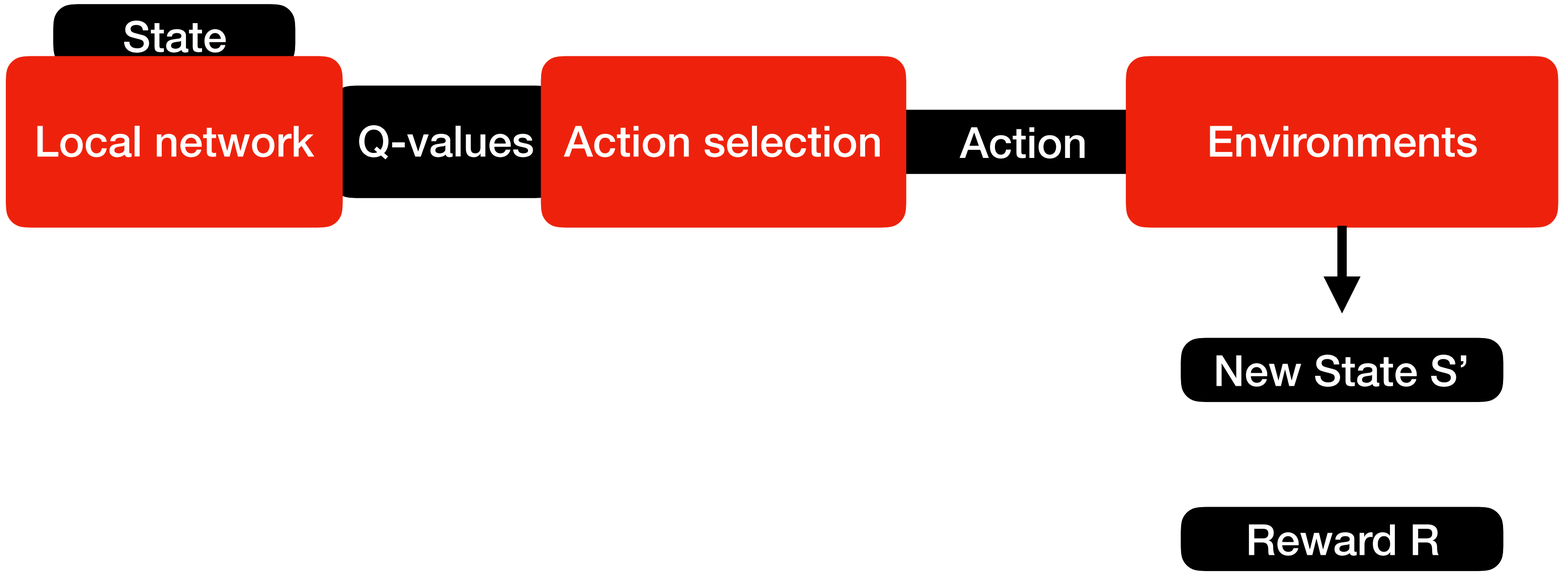
How are we going to update the Q-networks weights



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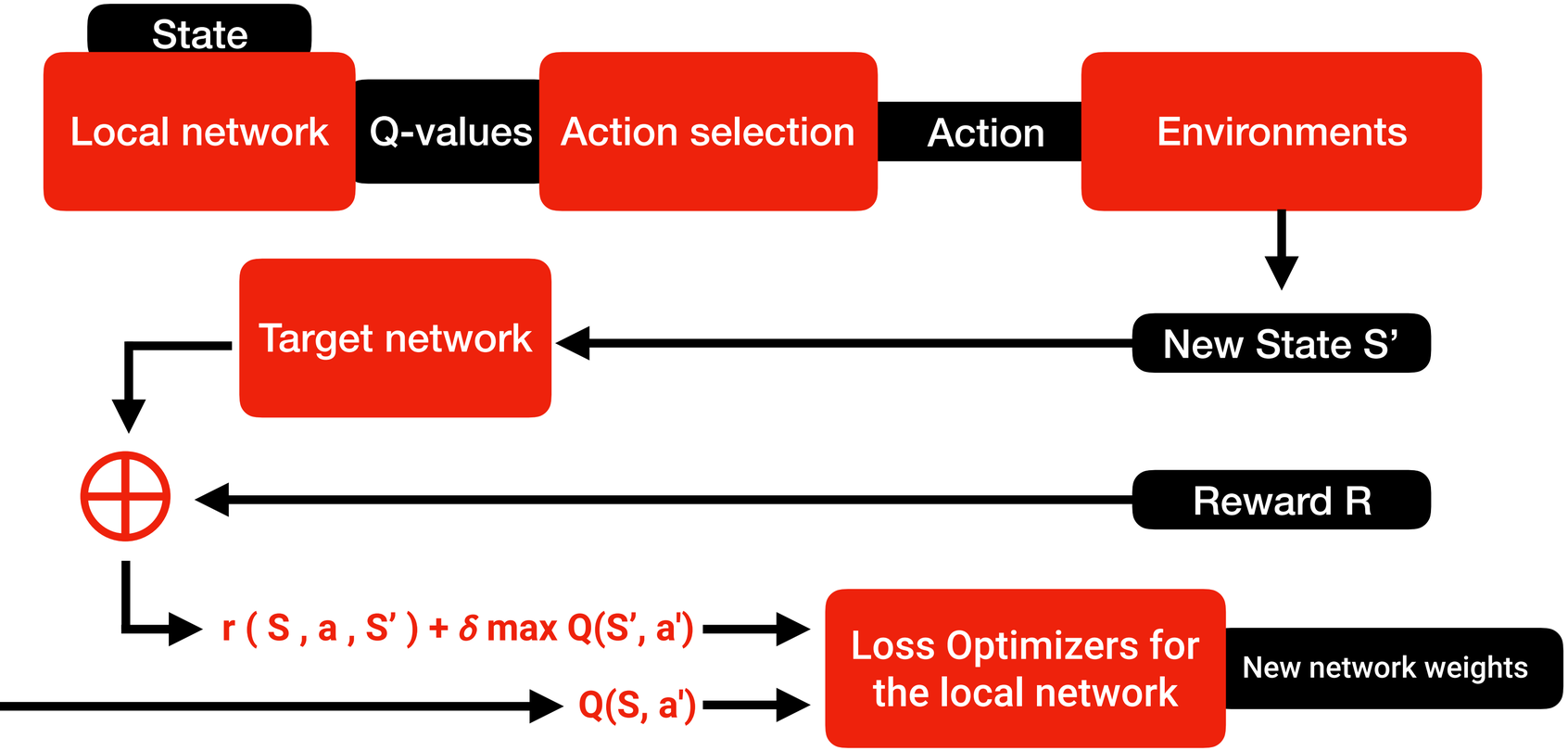

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Someone to answer the question please

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If not shuffling data, the data can be sorted or similar data points will lie next to each other, which leads to slow convergence

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If not shuffling data, the data can be sorted or similar data points will lie next to each other, which leads to slow convergence

In our case we are having a big correlation between consecutive states which may lead to inefficient learning .

How to break the coloration between states

Stack the experiences in a buffer

After the specified number of steps pick an N random experiences

Proceed with optimizing the loss with the learning batch

1 - How to replace the Q-table ✅

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3 - T-target ✅

4 - Experience replay

How to break the coloration between states

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2 - How to optimize the model ✅

3 - T-target ✅

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Putting it all together

Build a DQL agent

Saha ftourkoum