Deep Reinforcement Learning

Exercise 3

Student: Arseni Pertzovskiy, ID: 317377372.

a) [35 pts] DQN

An implementation is inside the code.

b) [15 pts] Replay Buffer

An implementation is inside the code.

c) [10 pts] Hard Target Network-Update

An implementation is inside the code.

d) [10 pts] Soft Target Network-Update

An implementation is inside the code.

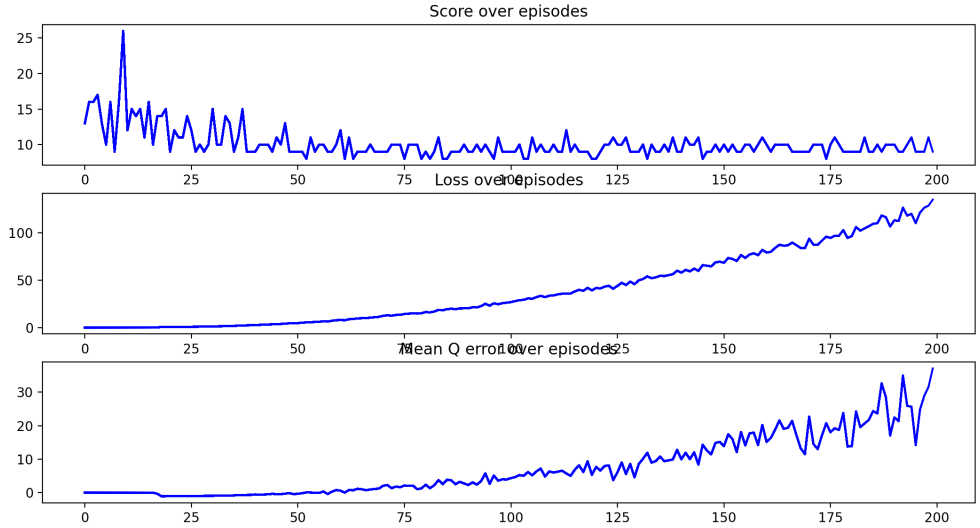
e) [25 pts] Effect of Replay Buffer and Target Network

An implementation of weights storage is inside the code.
The table with final result:

target update	with replay with target	with replay without target	without replay with target	without replay without target
hard	195.2	x	9.4	x
none	x	9.8	x	9.4
soft	188.6	x	9.6	x

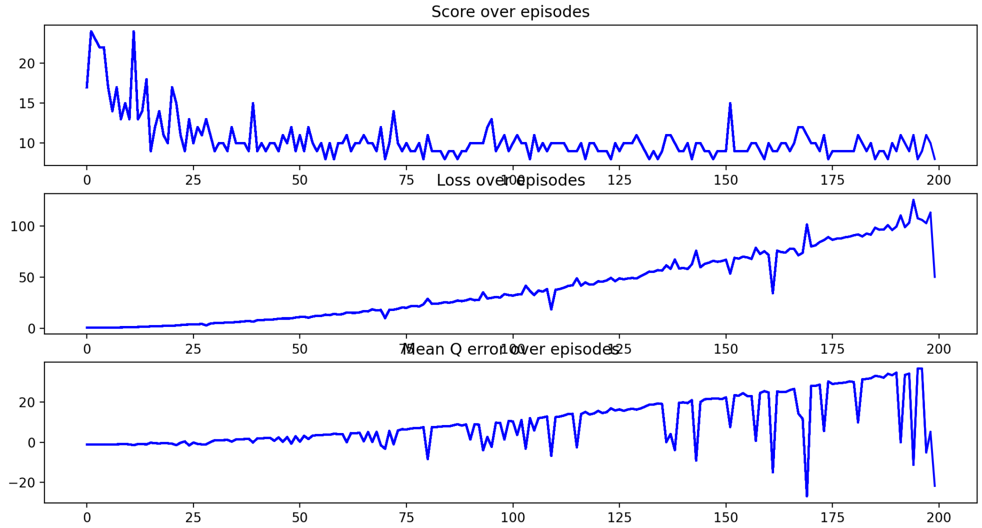
Each cell is the mean of five experiments with corresponding setting.

With replay – Without target – None



Loss over episodes as well as mean Q error over episodes had grown with an increasing pase over the run. We are gaining inferior results.

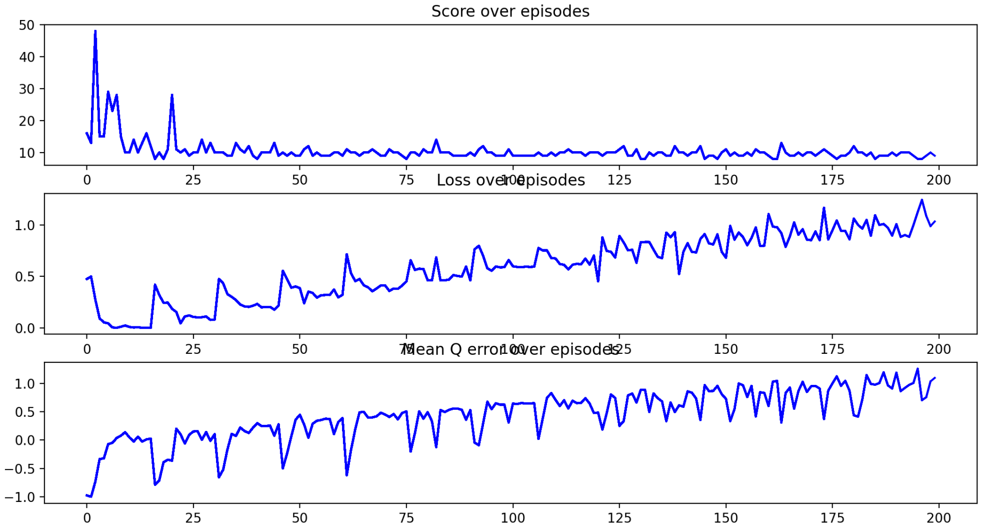
<u>Without replay – Without target – None</u>



Loss over episodes as well as mean Q error over episodes had grown with an increasing pase over the run. We are gaining even more inferior and less stable results that the previous one.

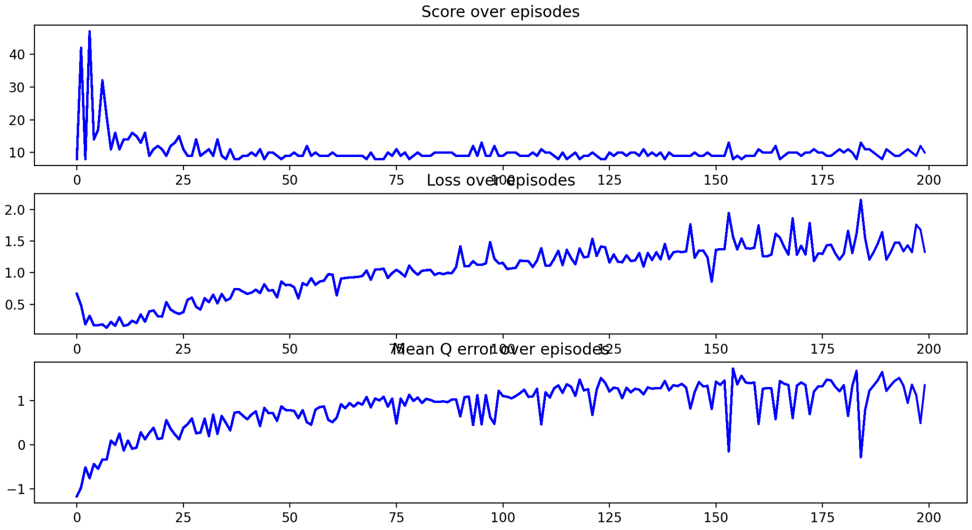
Investigation of soft and hard target updates (the difference we can observe in the loss and mean Q error)

<u>Without replay – With target – Hard</u>



Last two experiments we saw loss over episodes is in between [0, 100+] range as well as mean Q error over episodes is between [0, 30+] range. While introducing target network we are already droped both ranges to [0, 1] in loss and [-1, 1] in mean Q error. The update occuring each 15 episodes therefore we can observe an cyclic behavior in the graph.

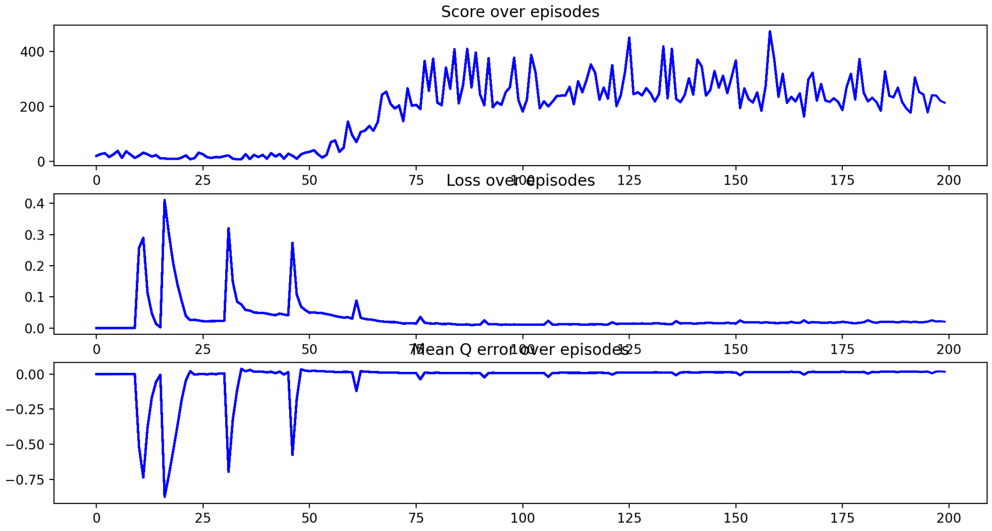
<u>Without replay – With target – Soft</u>



In the experiments without target net we saw loss over episodes is in between [0, 100+] range as well as mean Q error over episodes is between [0, 30+] range. While introducing target network we are already droped both ranges to [0, 2] in loss and [-1, 2] in mean Q error. The update occuring in a soft manner therefore we can observe more smooth growth (and not any cyclic behaviors as with 'hard update' case) in the graph.

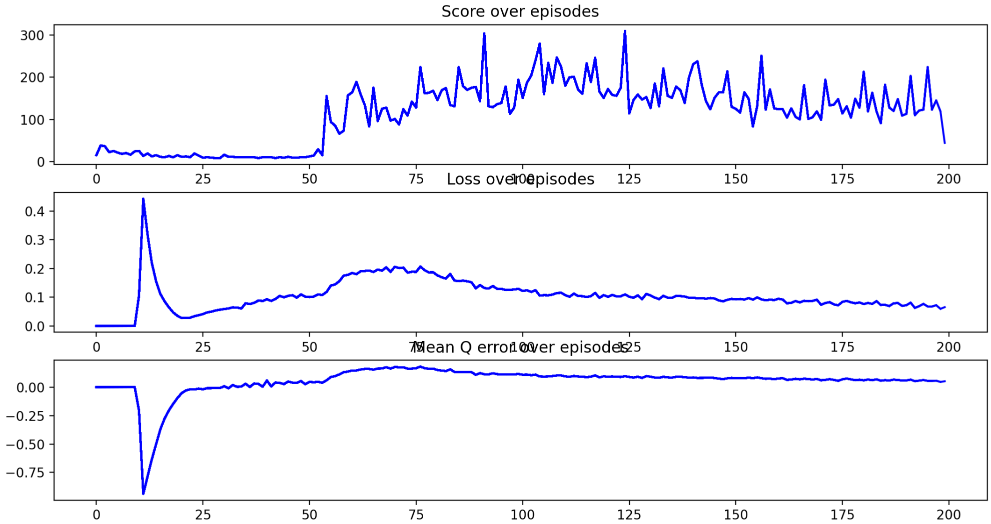
But still we are achiving highly inferior results in both cases.

With replay – With target – Hard



While combining both replay buffer and target net we are jumping in our performance and gainig the best results in the experiment. Loss over episodes as well as mean Q error over episodes decreasing over time and the score gets it's best. The cyclic behavior proper to 'hard update' can be observed on the graph. The algorithm gets at some point it's 'ceiling' and remains with approximatly same results (converges). Maybe some parameters tunning can help to improve perfomance.

With replay – With target – Soft



The changings of loss over episodes and mean Q error over episodes are much more smooth than with the 'hard' case. As we said earlier, the algorithm gets at some point it's 'ceiling' and remains with approximatly same results (converges). Maybe some parameters tunning can help to improve perfomance.

Because of a stochastic nature of the problem, each approach we gain a little bit different results, therefore sometimes 'soft' and sometimes 'hard' manner of update wins in term of total score.

f) [5 pts] Movie

Attached to the submition.
Best performing agent: with replay, with target, hard weights update.

End