Deep Reinforcement Learning On Blackjack

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Project goal

- Our goal is to teach the computer (the agent) how to play Blackjack and finding strategy to reduce player's loss.

Project description

- For the game environment we used OpenAI Gym platform.

- In this environment we have a small size of states:

$$|observation\ space| = (32,11,2)$$

- 32 - Possible values of sum of the agent's cards.
- 11 - Possible value of the visible card of the dealer.
- 2 – If the player has usable card.

- Due to the small number of situations, we used Q-Learning table for the training.

Experiments and results

- In order to test our model we built 3 agents to compare the results:
  - ❑ Random agent - selects random actions.
  - ❑ Auto agent - takes cards until he reaches an sum of 17.
  - ❑ Q-Learning agent –selects the optimal action according to the Q-table.

We ran the agents for 1000 games:

```
shimon@shimon-UX330UAK:~/Downloads$ python3 main.py
# Random play #
Average loss for 1000 rounds:  -325.4
# Auto play #
Average loss for 1000 rounds:  -283.15
# Training #
# Testing #
Average loss for 1000 rounds:  -109.0
[368, 71, 528, 34, -109.0]
shimon@shimon-UX330UAK:~/Downloads$ 
```

Conclusions

- With the help of our agent we were able to reduce the player's loss:
  - ❑ Random agent - average loss of 350 points (for 1000 games).
  - ❑ Q-Learning agent - average loss of 100 points (for 1000 games).

- We received a table describing the agent's strategy after the learning process.

Strategy table

	A	2	3	4	5	6	7	8	9	10		A	2	3	4	5	6	7	8	9	10
	Without usable ace											With usable ace									
4	S	S	S	S	S	S	S	S	S	S	12	S	S	S	S	S	S	S	S	S	S
5	H	H	H	H	H	H	H	H	H	S	13	H	H	H	H	H	H	H	H	H	H
6	H	H	H	H	H	H	H	H	H	H	14	H	H	H	H	H	H	H	H	H	H
7	H	H	H	H	H	H	H	H	S	H	15	H	H	H	H	H	H	H	H	H	S
8	H	H	H	H	H	H	H	H	H	S	16	H	H	H	H	H	H	H	H	S	H
9	H	H	H	H	H	H	H	H	H	H	17	H	H	H	H	H	H	H	H	H	S
10	H	H	H	H	H	H	H	H	H	S	18	H	H	S	H	H	H	H	H	H	H
11	H	H	H	H	H	H	H	H	H	H	19	H	H	S	H	S	H	S	H	H	S
12	H	H	H	H	H	H	H	H	H	H	20	S	S	H	S	S	H	S	S	S	H
13	H	S	H	H	H	H	H	H	S	H	21	S	S	S	S	H	S	S	S	S	S
14	S	H	S	H	S	H	S	H	H	H											
15	H	H	S	S	S	H	H	H	S	S											
16	S	S	S	S	S	S	H	S	S	H											
17	H	H	S	S	S	S	H	S	H	H											
18	S	H	S	S	S	S	S	H	H	S											
19	S	S	S	S	S	S	S	S	S	H											
20	S	S	S	S	S	S	S	S	S	S											
21	S	S	S	S	S	S	S	S	S	S											

```
netanelhugi@netanelhugi-X556URK: ~/Dropbox/DeepLearning/Games/BlackJack

File   Edit   View   Search   Terminal   Help

NEW GAME:
Player: [8, 10] Sum: 18
Dealer: [8]  Sum:  8
1-hit or 0-stay(Recommended action: Stand):0
Player: [8, 10] Sum: 18
Dealer: [8, 10]  Sum:  18
Draw!
0.0
```

```
netanelhugi@netanelhugi-X556URK: ~/Dropbox/DeepLearning/Games/BlackJack

File   Edit   View   Search   Terminal   Help

NEW GAME:
Player: [7, 4] Sum: 11
Dealer: [10]  Sum:  10
1-hit or 0-stay(Recommended action: Hit):1
Player: [7, 4, 10] Sum: 21
Dealer: [10]  Sum:  10
1-hit or 0-stay(Recommended action: Stand):0
Player: [7, 4, 10] Sum: 21
Dealer: [10, 10]  Sum:  20
Player won!
1.0
```