

Reinforcement Learning and Odds-Calculation for Hold'em Limited Poker

Artificial Intelligence - WS 17/18

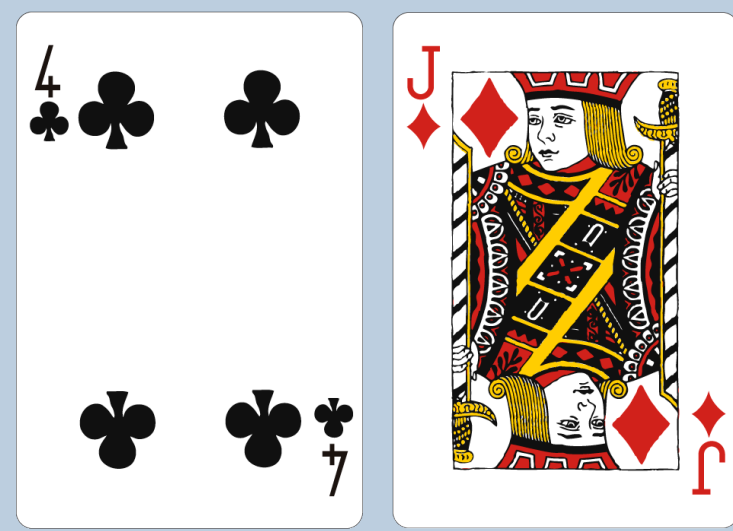
Maximilian Klingmann, Julien Stern
 {m.klingmann, j.stern}@stud.uni-heidelberg.de



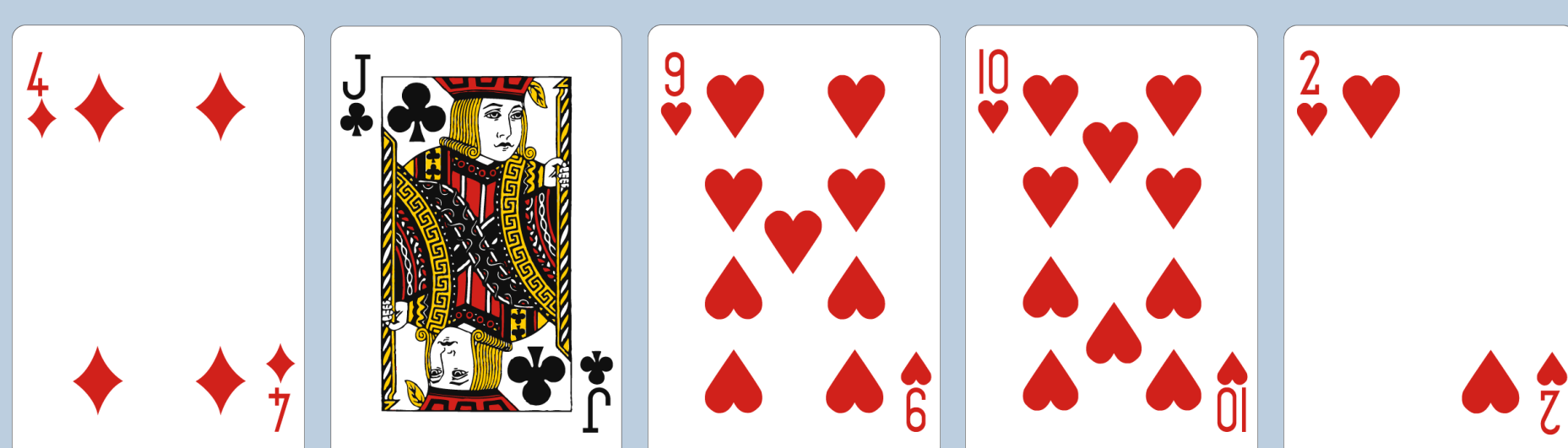
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Texas Hold'em Poker

Hole Cards



Community Cards

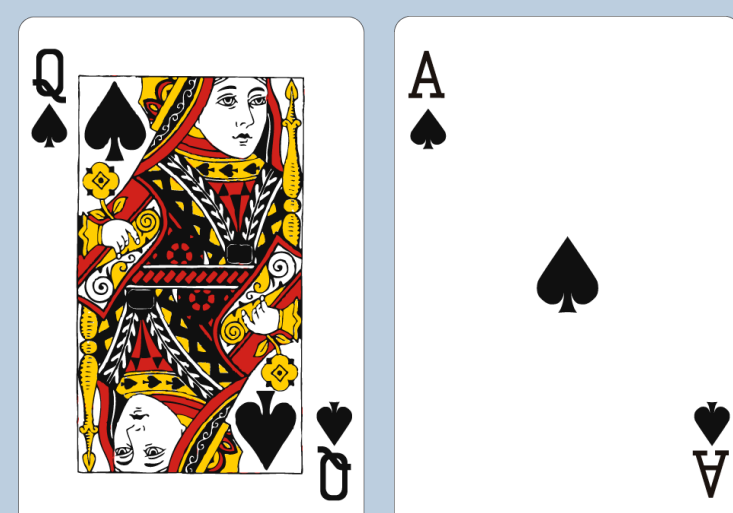


- Every player gets their individual Hole Cards (hidden)
- Community Cards can be used by everyone (open)
- Hand: 5 best cards from Hole Cards + Community Cards
- Best Hand wins the round!

Chen Formula

- Assigns scores to Hole Cards based on heuristics
- Used by Odds- and Q-Bot in pre-flop stages
- Scores consider (example):

- Highest Card (+10)
- Pair Score (*1)
- Suited Score(+2)
- Closeness Score (-1)
- Connected Score (+0)



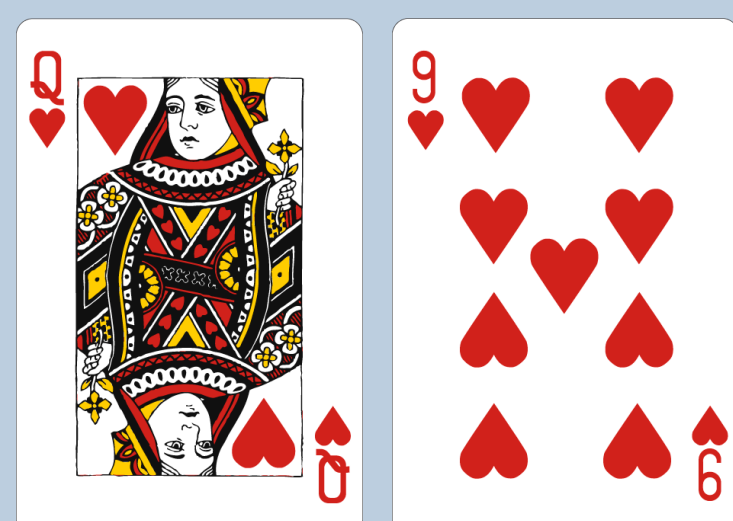
Score: 11

Odds-Bot

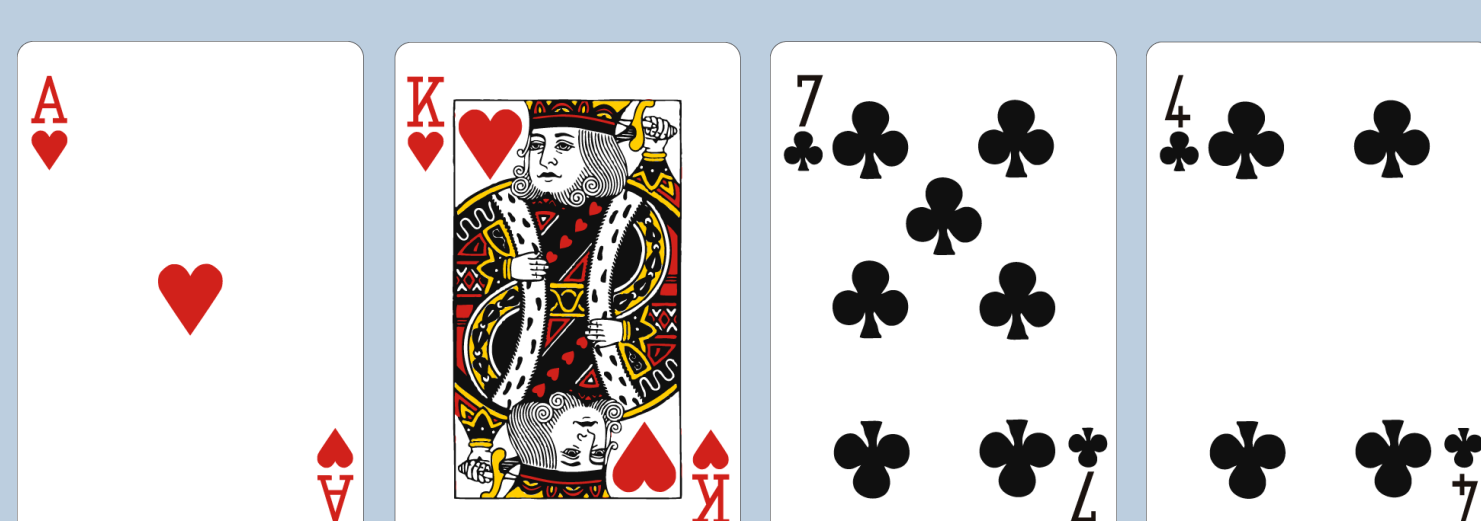
- Calculates Odds to predict a win/loss
- Odds: Probability to win the round

Example:

Hole Cards



Community Cards (turn)



- 13 Cards in each suit and 4 Hearts visible
- Following that 9 Hearts still available in deck
- Their are 46 unseen Cards
- Their are $46 - 9 = 37$ Cards that do not improve the Hand
- Odds of getting the Card you need are 1:4 (9:37)
- To call: 10 and pot size: 100 (1:10)
- Following $1:4 > 1:10 \Rightarrow$ Call

Q-Bot

- Learns by updating a Q-List
- Q-List holds states and corresponding actions
- Q updates as follows:

$$Q(s, a) = \frac{1}{n} (Q(s, a) - (r + \max_{a'}(Q(s', a'))))$$

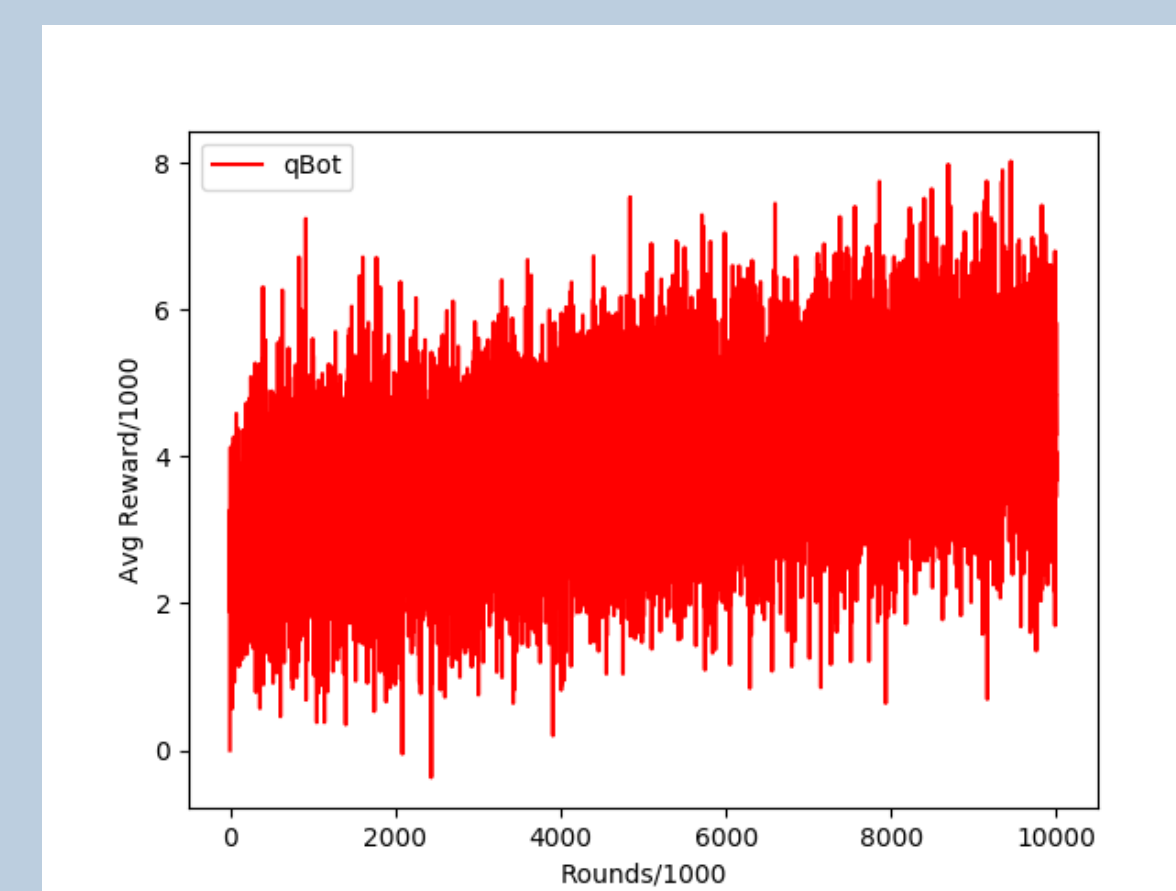
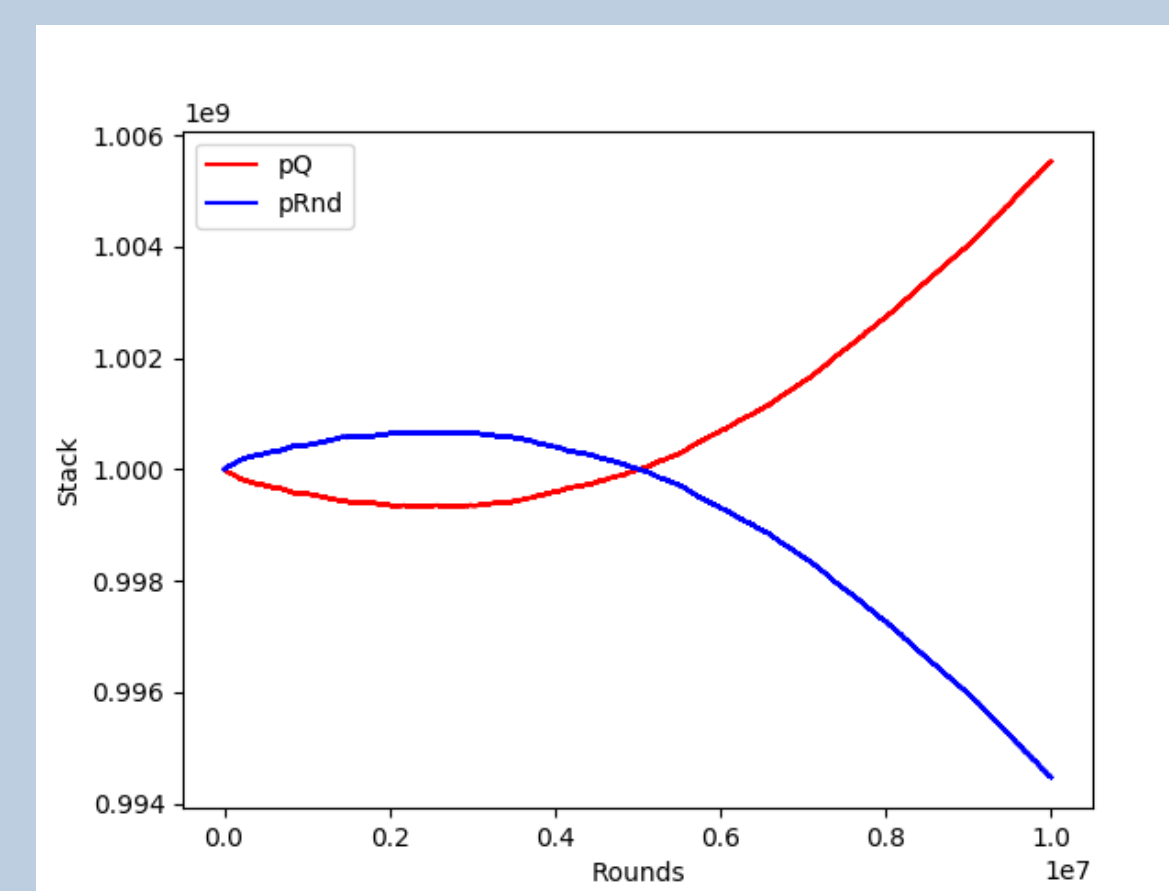
- Feature vector:

(stage, BB-position, Raises, Hand-Strength)

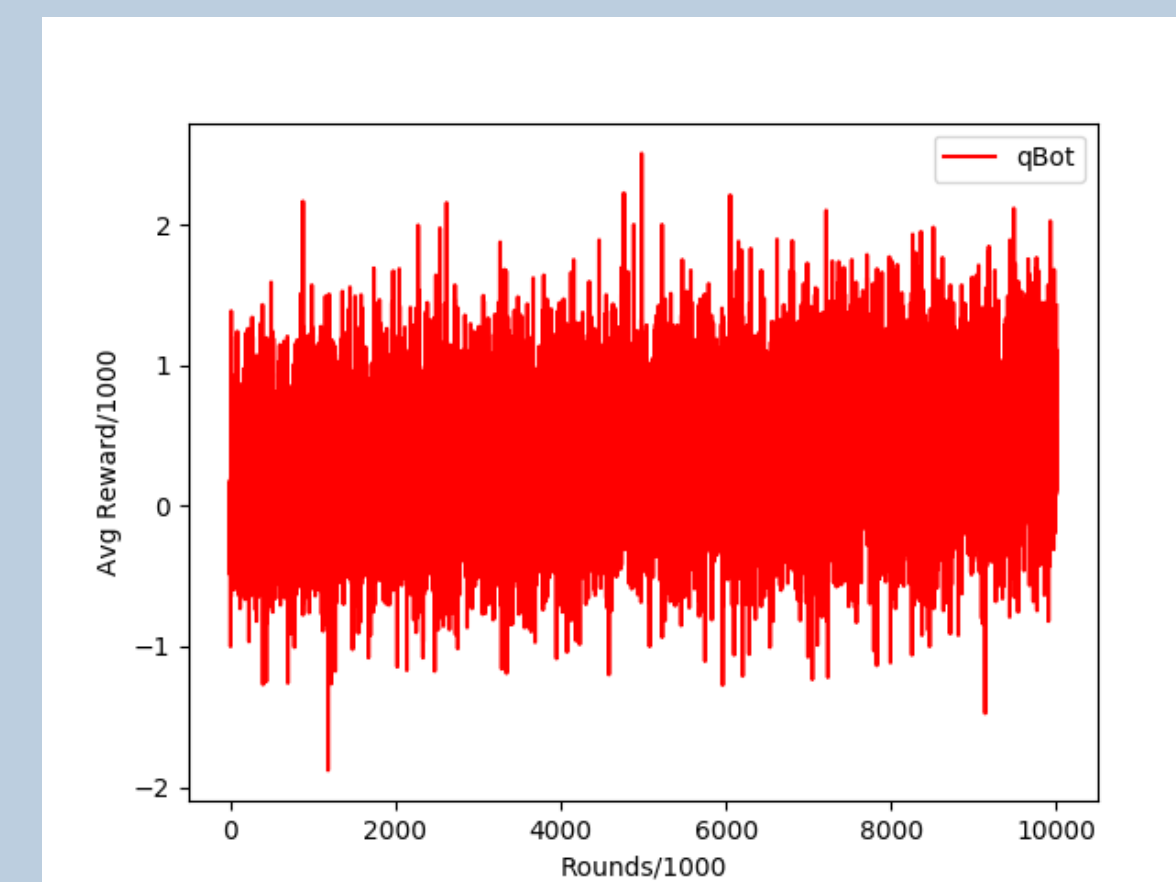
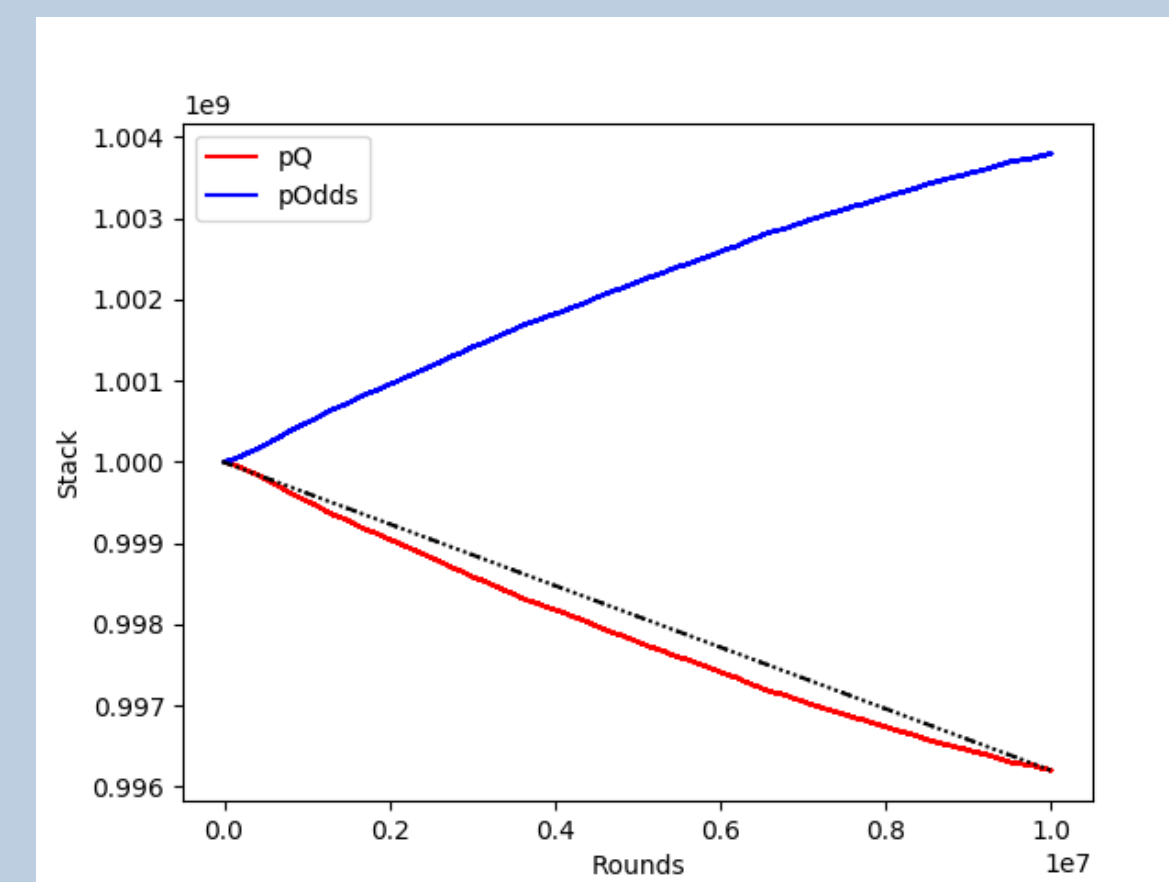
Experimental Evaluation

- Texas Holdem Limited Poker
- Used game engine: pypokerengine
- Baseline 1: Random-Bot (6% change to fold)
- Baseline 2: MonteCarlo-Bot chooses action by simulation
- Graphs show stacks or average reward for Q-Bot

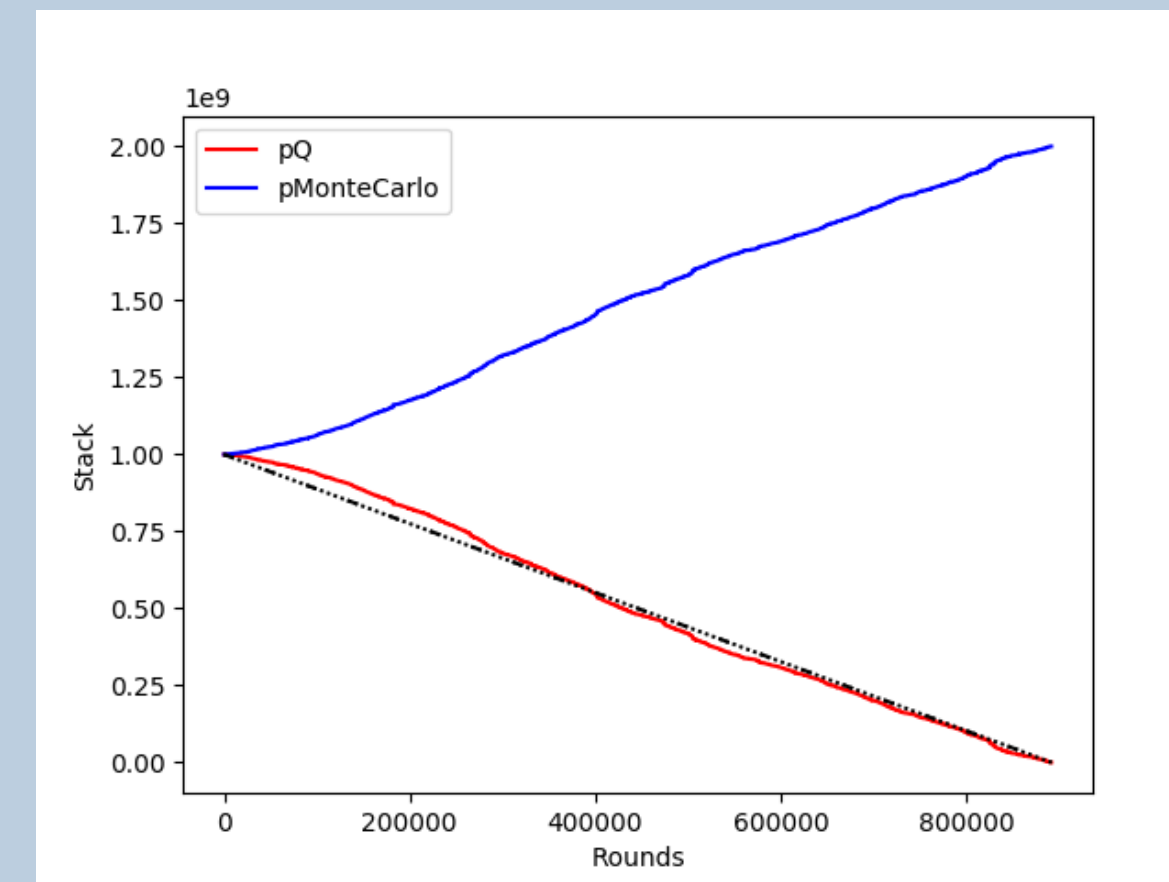
Q-Bot vs. Random-Bot



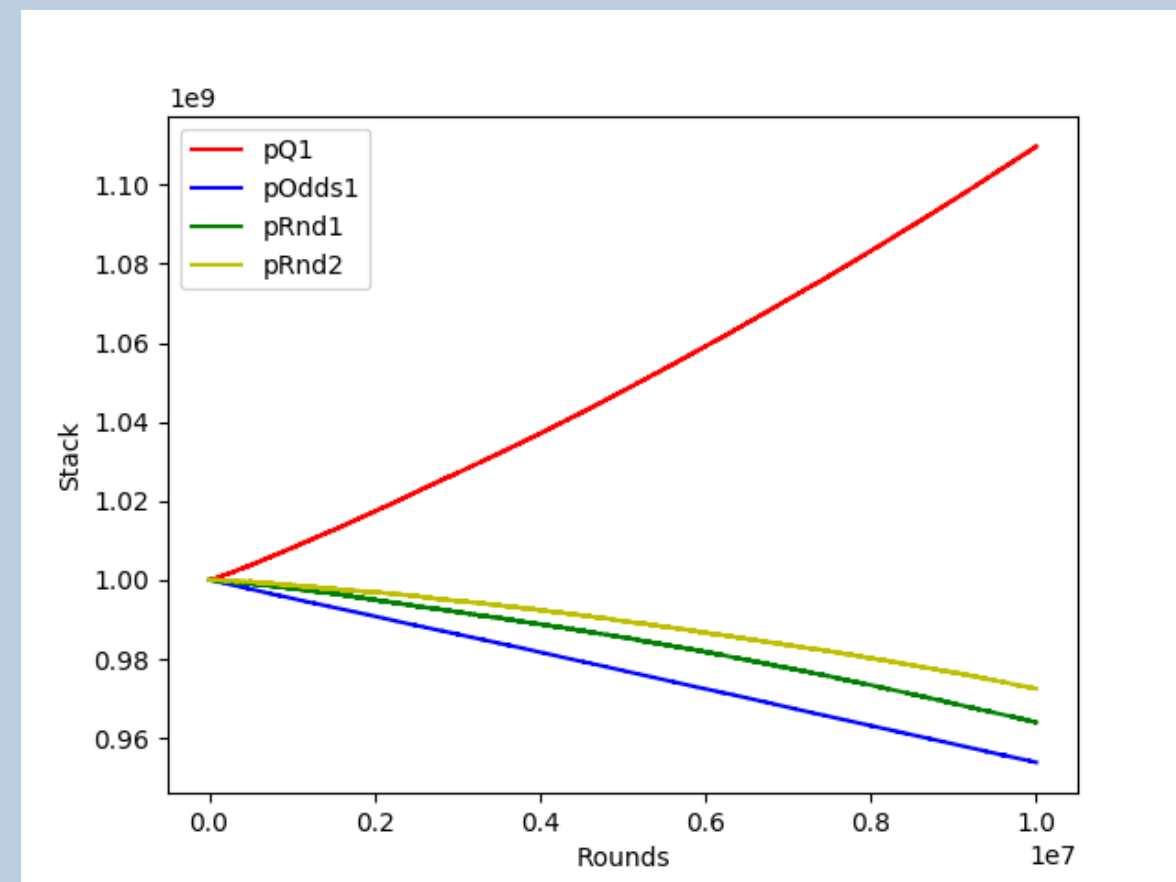
Q-Bot vs. Odds-Bot



Q-Bot vs. MonteCarlo-Bot



4-player table game



References

- [1] PETER ROMOV: *pypokerengine*, <https://github.com/sberbank-ai/holdem-challenge/tree/master/PyPokerEngine>
- [2] BILL CHEN: *Chen Formula*, The Mathematics of Poker, Conjelco, ISBN 1-886070-25-3, 2006
- [3] CARDSCHAT.COM: *Odds*, <https://www.cardschat.com/odds-for-dummies.php>, 2018
- [4] ALBERT TUNG, ERIC XU, AND JEFFREY ZHANG: *BetaPoker: Reinforcement Learning for Heads-Up Limit Poker*, 2017