

Pokerbots 2021

Lecture 2: Poker Theory

Sponsors



TWO SIGMA

Giveaways

Resume Giveaway!
pkr.bot/resume-raffle

Drop Resume:
pkr.bot/drop

Giveaway Game:
pkr.bot/haircut

Logistics

Engine and C++ Update
Piazza post @32

Find Teammates!
Piazza post @5

Study Break!
5pm EST Today

Find Your Teammates!

Intro to Programming!

Piazza post @36

Week 1 bot deadline:
Friday Jan 8,
11:59 p.m EST

Scrimmage Server

Example Tournament

Agenda

- Hand types
- Pot odds
- Ranges
- Variant strategic considerations
- Coding reference-lecture-2 bot

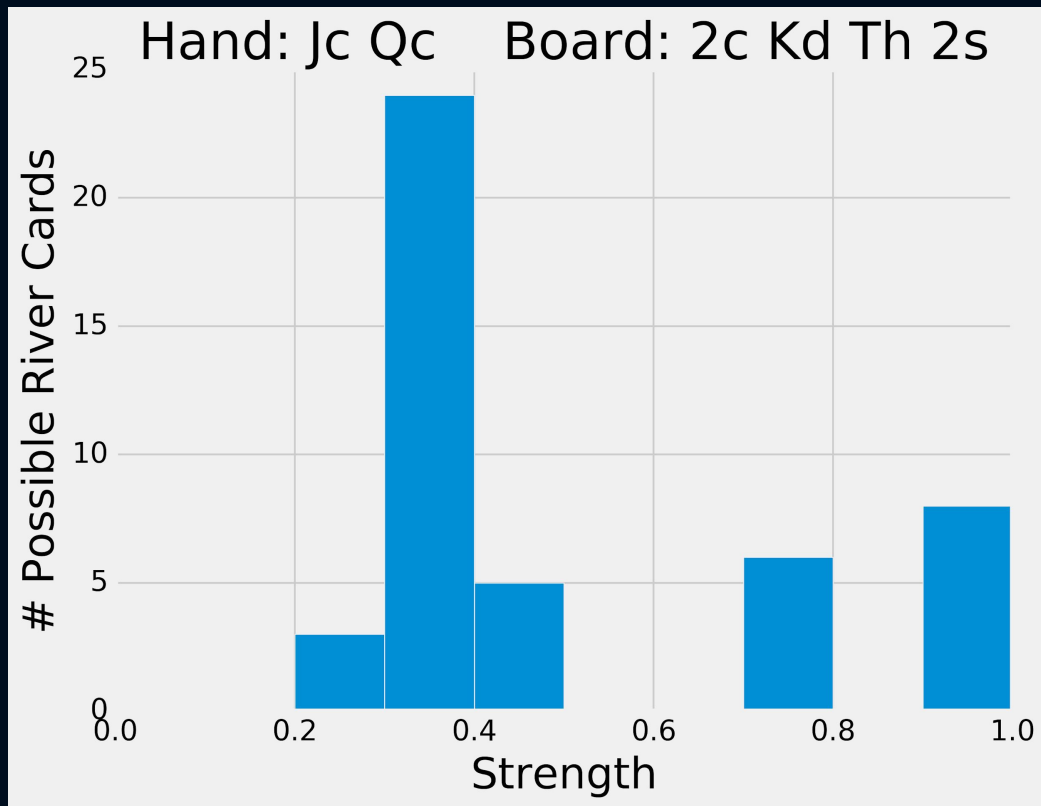


Hand types

Drawing hand



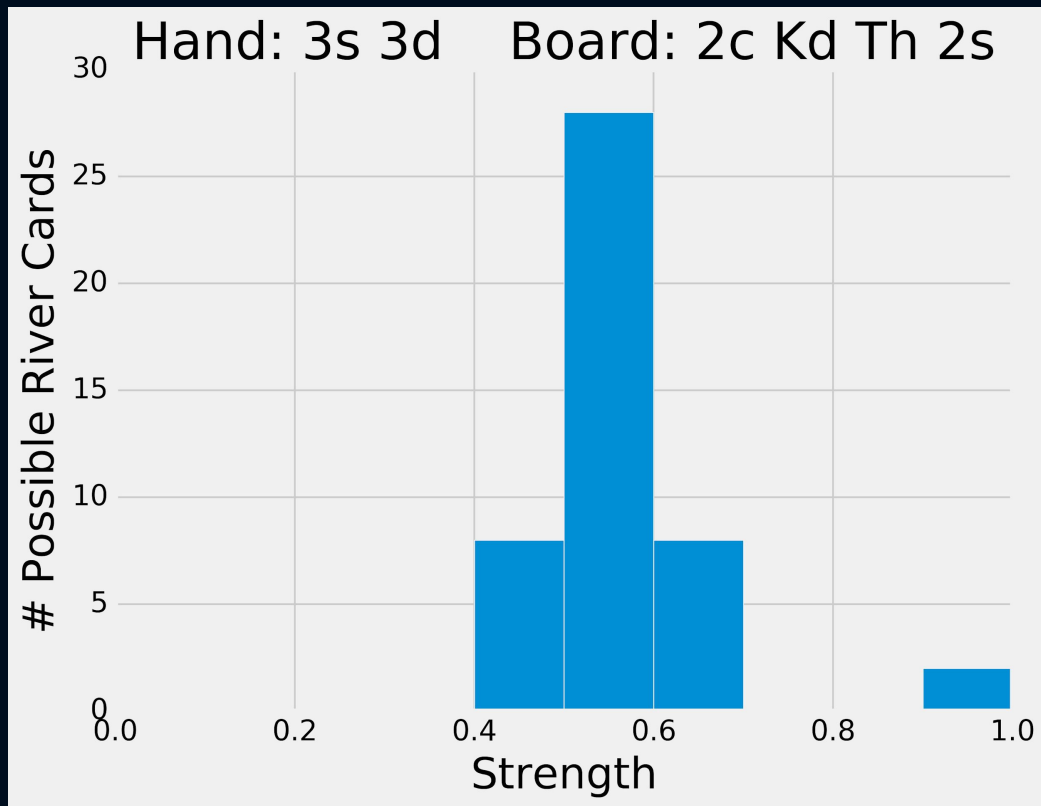
Drawing hand



Low pair



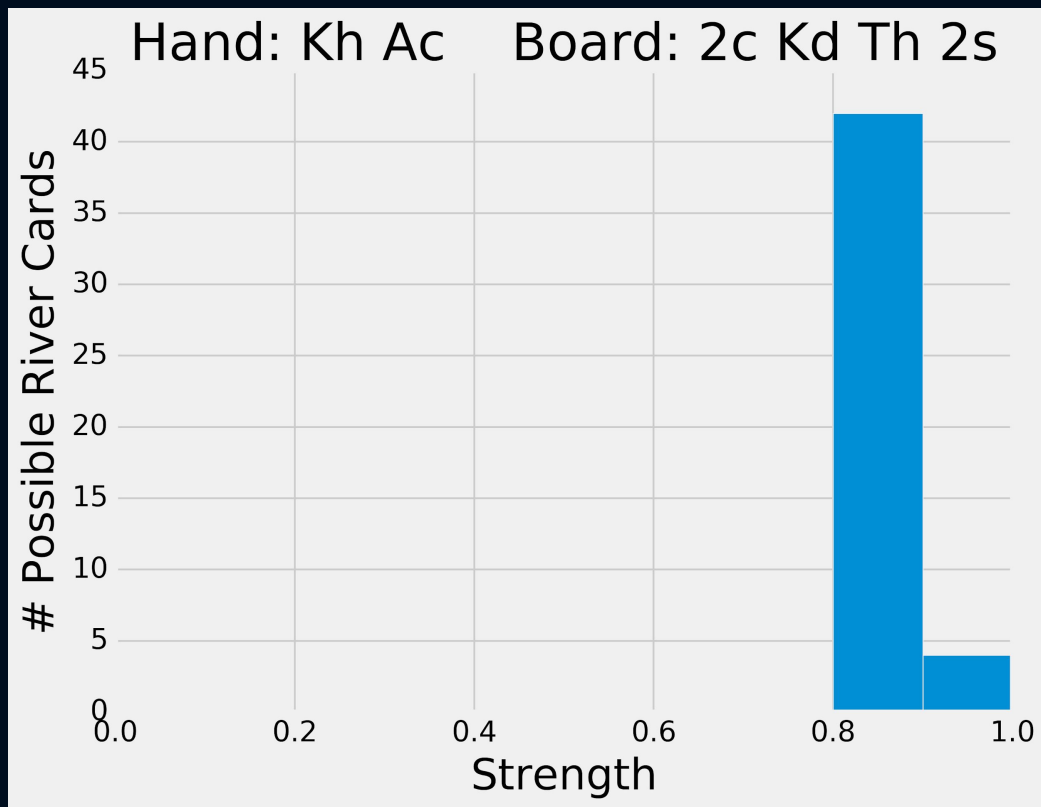
Low pair



Made hand



Made hand



“The nuts”



“The nuts”





Board types



How would you feel about your hand strength here?



What about here?



Pot Odds & Outs

Pot odds

- Claim: for any state of the game, there exists some probability p of winning
- This depends on our opponent's strategy, but let's ignore that for now

$$0 \leq p \leq 1$$

Calculate expected value

$$p \cdot \text{pot_total} - (1 - p) \cdot \text{continue_cost}$$

>0?

=0?

<0?

Separate p

- Cutoff: we should stay in the game if

$$p \geq \text{continue_cost} / (\text{pot_total} + \text{continue_cost})$$

- Right-hand side is called the *pot odds*

Exercise



40



40



Exercise



50?



40



Example pot odds

- $\text{pot_total} = 90$
- $\text{continue_cost} = 10$
- $\text{pot odds} = 10 / (90 + 10) = 0.1$
- If $p \geq 0.1$, we should call!

How do we know what p is?

Counting outs

Idea: If we know which cards we need to complete our hand, we can estimate the probability of getting those cards. If our hand is strong, this estimates our probability of winning the game (p)!

Strategy:

- Count the number of cards that complete our hand (*outs*)
- Multiply this number by 2 (*52 cards gives ~2% chance of getting a specific card*)
- If we have two cards left to see, multiply by 2
- This number is our probability estimate! (*as a percent*)

Exercise



50?



40



Calculating p

- outs = 8
- probability of completing the hand is $8 * 2 = 16\%$
- $p = 0.16$
- pot odds = 0.1
- p is greater than our pot odds - we should call!

Reverse pot odds

- If we overbet relative to the size of the pot, then we give our opponent the opportunity to exploit pot odds
- If they have a bad hand, we win a little
- If they have “the nuts,” we lose a lot

Example: the all-in bot

- Our opponent goes all-in on the preflop (deterministic!)
- We can check-fold, letting our opponent collect the blinds, until we are dealt a high pair to crush them and win big



Ranges

Ranges

- We know the pot odds when faced with any bet
- If we can estimate p better than our opponent, then we will make money on average
- What affects p ?

Factors of win probability

- Bluffing
- Betting style
- Board and Hole cards
- *Ranges*

Our opponent's *range*
is the distribution of
hands we expect
them to hold

Range Exercise



40



40



Updating Ranges

- Use opponents actions to narrow range
- "Everything conveys information"
- How do your cards compare to their range?
- What about your range?

Which ranges are good?

- Tight-aggressive
- Fold early and often to mitigate losses
- Bet and win when you have a good hand!

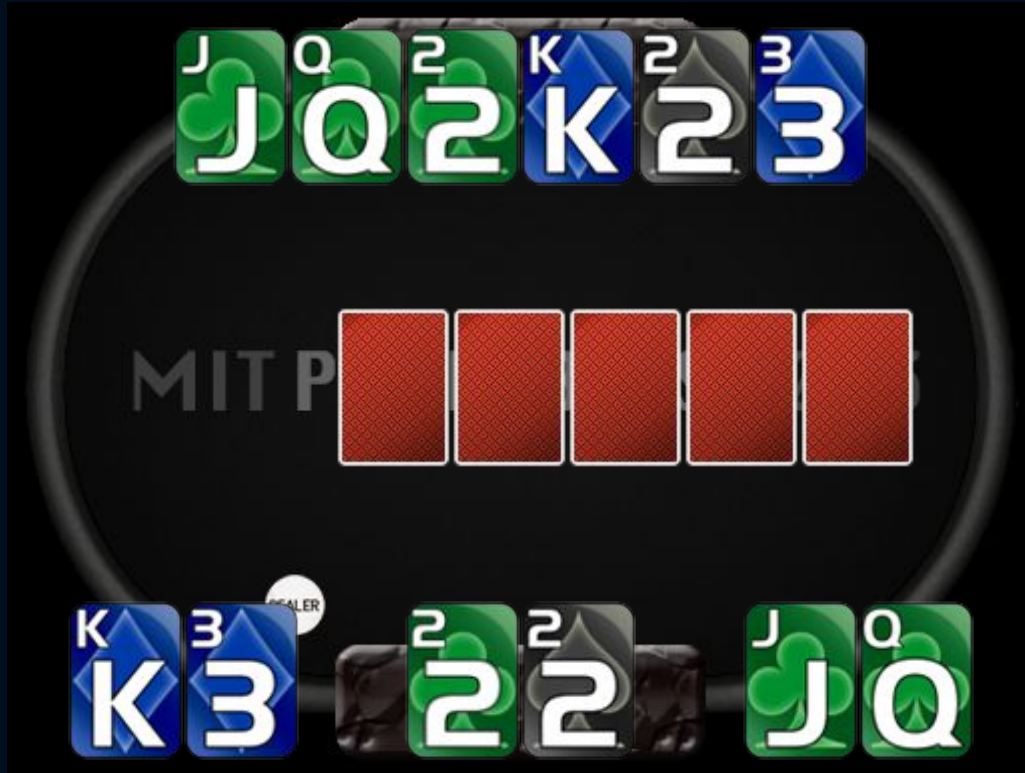
The background is a solid dark blue. On the left side, there are several overlapping, semi-transparent shapes in a lighter shade of blue. These shapes include a large triangle pointing upwards and a large circle, creating a layered, abstract effect.

Variant strategic considerations

Blotto Hold'em

- Different hand types can be made with the 6 cards dealt preflop
- Allocating cards to boards while considering opponents ranges
- Preflop pot odds and raise sizing are changed dramatically
- Pot control and bankroll management are more important
- All ins!

Hand pairing and allocation



Bankroll Management/Pot Odds Exercise



2



6



1





Coding reference-lecture-2 bot

Goals

- Improve our betting strategy
- Implement pot odds
- Incorporate randomness
- Monte Carlo simulation for card strength estimation (p)

Monte Carlo Simulation

- Helps us estimate values by using randomness and sampling
- Simulates a process many times to see what happens on average
- We can estimate our hand strength by simulating poker games many times
- The proportion of wins from the simulations is our win probability!

Giveaway Winners

Stephen's Hair Length:
15.34 inches