



**GARVIT MEENA**  
**B20ME033**

**OPPONENT MODELING IN POKER**

A VIDEO OVERVIEW OF THE RESEARCH PAPER NAMED AS “OPPONENT MODELING  
IN POKER”.



# INTRODUCTION

ONE OF THE MOST POPULAR VARIATIONS OF THE CARD GAME POKER IS TEXAS HOLD'EM. EACH PLAYER IS HANDED TWO HOLE CARDS, WHICH ARE DEALT FACE DOWN, AND THEN FIVE COMMUNITY CARDS ARE DEALT FACE UP IN THREE PHASES. A SUCCESSION OF THREE CARDS ("THE FLOP"), FOLLOWED BY A SINGLE CARD ("THE TURN"), AND FINALLY A SINGLE CARD ("THE RIVER"). EACH PARTICIPANT TRIES TO MAKE THE FINEST FIVE-CARD POKER HAND POSSIBLE USING ANY COMBINATION OF THE SEVEN CARDS AVAILABLE TO THEM: THE FIVE COMMUNITY CARDS AND THEIR TWO HOLE CARDS. CHECK, CALL, RAISE, OR FOLD ARE THE BETTING CHOICES AVAILABLE TO PLAYERS. BEFORE THE FLOP IS DEALT, AND AFTER EACH CONSECUTIVE DEAL, THERE ARE ROUNDS OF BETTING. THE PLAYER WITH THE BEST HAND AND WHO HAS NOT FOLDED AT THE END OF ALL BETTING ROUNDS WINS THE POT, WHICH IS THE TOTAL AMOUNT OF MONEY WAGERED ON THE HAND. WHEN TWO PLAYERS HOLD HANDS OF EQUAL VALUE, A "SPLIT-POT" OR "TIE" CAN OCCUR IN CERTAIN CONDITIONS.

# INFORMATION ABOUT POKER HANDS

**Poker Hand** - the 5 cards held in a game of poker

**Deal, Hand** - the cards held in a card game by a given player at any given time.

**Straight Flush** - a poker hand with consecutive cards in the same suit.

**Full House** - a poker hand with 3 of a kind and a pair.

**Flush** - a poker hand with all 5 cards in the same suit.

**Straight** - a poker hand with 5 consecutive cards (regardless of suit).

**Pair** - a poker hand with 2 cards of the same value.

All poker hands in the image are ordered in order to collect the largest bet and win the game!

## POKER HAND RANKINGS



Royal Flush



Straight



Straight Flush



Three Of A Kind



Four Of A Kind



Two Pair



Full House



One Pair





Flush



High End



WE WILL DIVIDE THE WHOLE MODEL OF OUR  
POKER PLAYING PROGRAMME INTO FOUR  
SUBPARTS.

- PRE-FLOP EVALUATION
  - HAND STRENGTH AND HAND POTENTIAL
  - BETTING STRATEGY
  - OPPONENT MODELLING
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A decorative graphic on the left side of the slide consisting of white lines and circles on a blue gradient background, resembling a circuit board or neural network.

# PRE-FLOP EVALUATION

THE POKER LITERATURE HAS DEVOTED A LOT OF ATTENTION TO PRE-FLOP PLAY IN HOLD'EM. BASED ON THE NUMBER OF PLAYERS, LOCATION AT THE TABLE, AND KIND OF OPPONENTS, A PROPOSED BETTING STRATEGY IS OFFERED FOR EACH CLASS OF HAND. TO OBTAIN A STATISTICAL MEASURE OF THE APPROXIMATE INCOME RATE (PROFIT EXPECTATION) FOR EACH STARTING HAND, A SIMULATION OF 1,000,000 POKER GAMES WAS RUN AGAINST NINE RANDOM HANDS.



# HAND STRENGTH AND HAND POTENTIAL

THREE PUBLIC CARDS (FLOP CARDS) ARE SHOWN AFTER THE FIRST ROUND OF BETTING. GIVEN THE THREE FLOP CARDS AND THE ASSUMPTION THAT THE OPPONENT IS HOLDING ONE OF THE 47 SELECT 2 DISTINCT PAIRS WITH EQUAL PROBABILITY, WE CALCULATE THE POSSIBILITY OF HOLDING THE BEST HAND. THIS POSSIBILITY IS CALLED "HAND STRENGTH". BECAUSE THERE ARE TWO MORE PUBLIC CARDS BEING OPENED, WE CAN'T PLAY EXCLUSIVELY ON THE BASIS OF HAND STRENGTH. IN GENERAL, WE NEED TO BE AWARE OF HOW THE POTENTIAL OF A HAND AFFECTS THE EFFECTIVE HAND STRENGTH. LET CONSIDER A HAND 5♥-2♥ WITH THE FLOP OF 3♥-4♣-J♥. THERE IS A HIGH PROBABILITY (OVER 50%) THAT THIS HAND WILL IMPROVE TO BECOME THE WINNING HAND, SO IT HAS A HIGH VALUE.



# BETTING STRATEGY

IT IS SUFFICIENT TO KNOW THAT BETTING STRATEGY IS BASED PRIMARILY ON TWO THINGS:

- EFFECTIVE HAND STRENGTH (EHS) INCLUDES HANDS WHERE WE ARE AHEAD, AND THOSE WHERE WE HAVE A P(POT) CHANCE THAT WE CAN PULL AHEAD:

$$EHS = HS(N) + (1 - HS(N)) * P(POT)$$

- POT ODDS ARE YOUR WINNING CHANCES COMPARED TO THE RETURN FROM A BET. IF YOU ASSESS YOUR CHANCE OF WINNING TO BE 25%, YOU WOULD CALL A \$4 BET A \$16 BET ( $4/(16+4) = 0.20$ ) BECAUSE THE POT IS IN YOUR FAVOR.





# OPPONENT MODELING

POKER IS A GAME WHERE THE OUTCOME OF THE GAME HEAVILY DEPENDS ON THE WAY YOUR OPPONENT PLAYS. OPPONENT MODELLING HAS ALWAYS BEEN IMPORTANT AND A CHALLENGING PROBLEM FOR PLAYERS TO SOLVE AS WELL AS AN IMPORTANT TOOL FOR STRATEGISTS TO USE IN POKER GAMES.

WE WILL DIVIDE THIS CHALLENGE OF OPPONENT MODELLING IN THREE SUBPARTS.

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**Weighing the Enumeration:** Weights are recomputed based on opponent actions. Each time player makes an action weights are modified. We use the weight which represents the probability that if opponent got that card he have not folded yet given actions taken by both players and cards opened till now and past history.

**Computing Initial Weight:** Initial weights are based on the history of game and opponent's actions. And then we use linear interpolation to calculate median and variance of income rate of raising, calling and folding.

**Reweighting:** For reweighing we multiply these factors with the weights to get new weights and do hand calculations based on these. We calculate the median hand required for an action and do linear interpolation around that to calculate reweighing factor.





# RESULTS

NOW TO CHECK THE EFFECTIVENESS OF THE DIFFERENT VERSIONS OF *LOKI* NAMED AS: BASIC PLAYER (BPM), BPT IS A “TIGHT” (CONSERVATIVE) PLAYER, BPL IS A “LOOSE” (MORE LIBERAL) PLAYER, GENERIC OPPONENT MODELING (GOM), SPECIFIC OPPONENT MODELING (SOM).

GOM IS ABLE TO EXPLOIT THE BASIC PLAYERS SINCE ITS MODEL OF HOW THEY PLAY IS ACCURATE AND IS USED TO MAKE BETTER DECISIONS.

USING OBSERVED FREQUENCIES RATHER THAN A GOOD DEFAULT MODEL, SOM IS MORE SUCCESSFUL. SOM'S ADVANTAGE OVER GOM WILL BE AMPLIFIED WHEN COMPETING AGAINST COMPETITORS WITH SIGNIFICANTLY DIFFERENT STYLES OF PLAY, AS IS TYPICAL IN HUMAN COMPETITION.

The background is a blue gradient with faint concentric circles. White circuit-like lines with circular nodes are positioned in the corners: top-left, top-right, bottom-left, and bottom-right.

**THANK YOU !**