BLACKJACK MINIMUM RISK ALGORITHM

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RULES OF BLACKJACK

- Blackjack refers to magic number 21.
- The goal of blackjack is to beat the dealer's hand without going over 21.
- Face cards are worth 10. Aces are worth 1 or 11, whichever makes a better hand.
- Each player starts with two cards, one of the dealer's cards is hidden until the end.
- If you go over 21 you bust, and the dealer wins regardless of the dealer's hand.
- If you are dealt 21 from the start (Ace & 10), you got a blackjack.
- Dealer will hit until his/her cards total 17 or higher.

Blackjack

CARD VALUES




= 10

= 1 OR 11

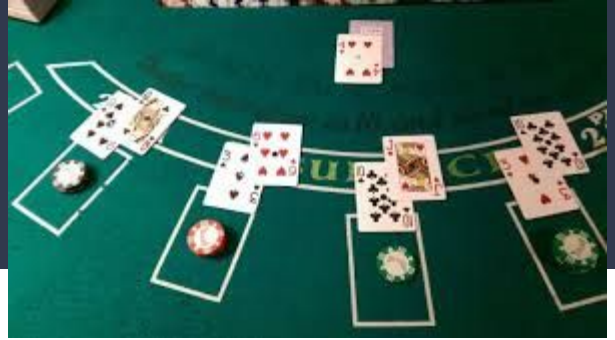


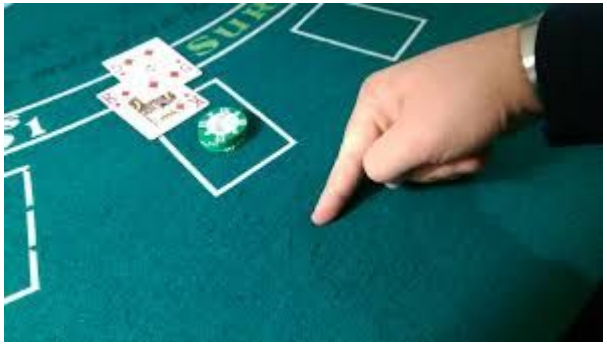


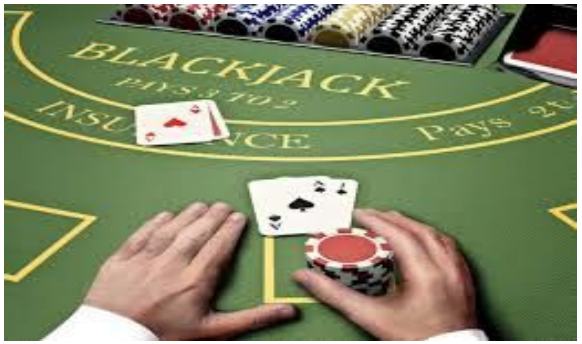


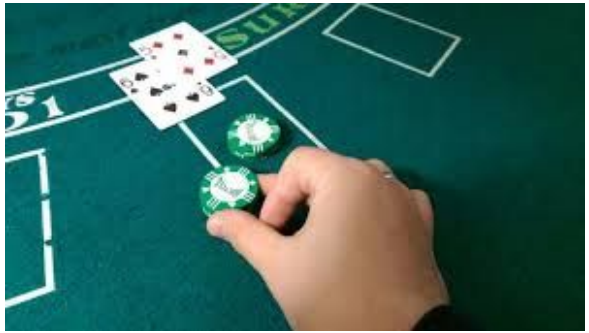

2 3 4 5 6 7 8 9

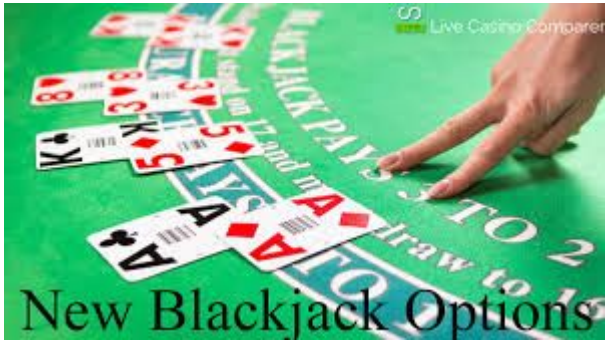
SYMBOLS











MOVES ALLOWED

HIT

Player draws a card from the deck. If the player is not busted he can again hit, stay or double down in the next move.

STAY

In this move, the player does nothing and waits for the dealer to gets busted or his total is sufficient to beat the dealer.

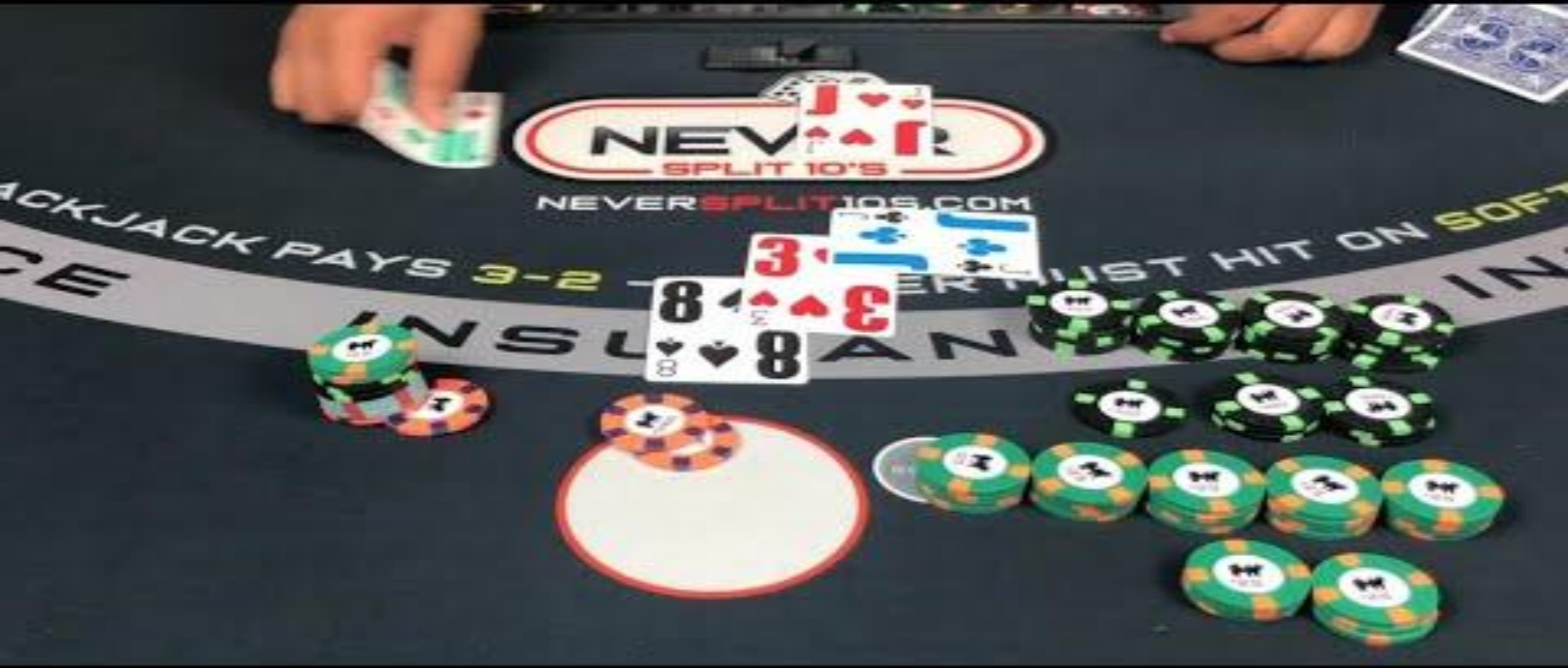
MOVES ALLOWED

Double Down

The player is confident about the next hit and he doubles the bet. After doubling down, the player is allowed to draw only one card.

SPLIT

When the player is dealt with same value cards he has an option to split his hand into two. Then he has to bet on both of his hands.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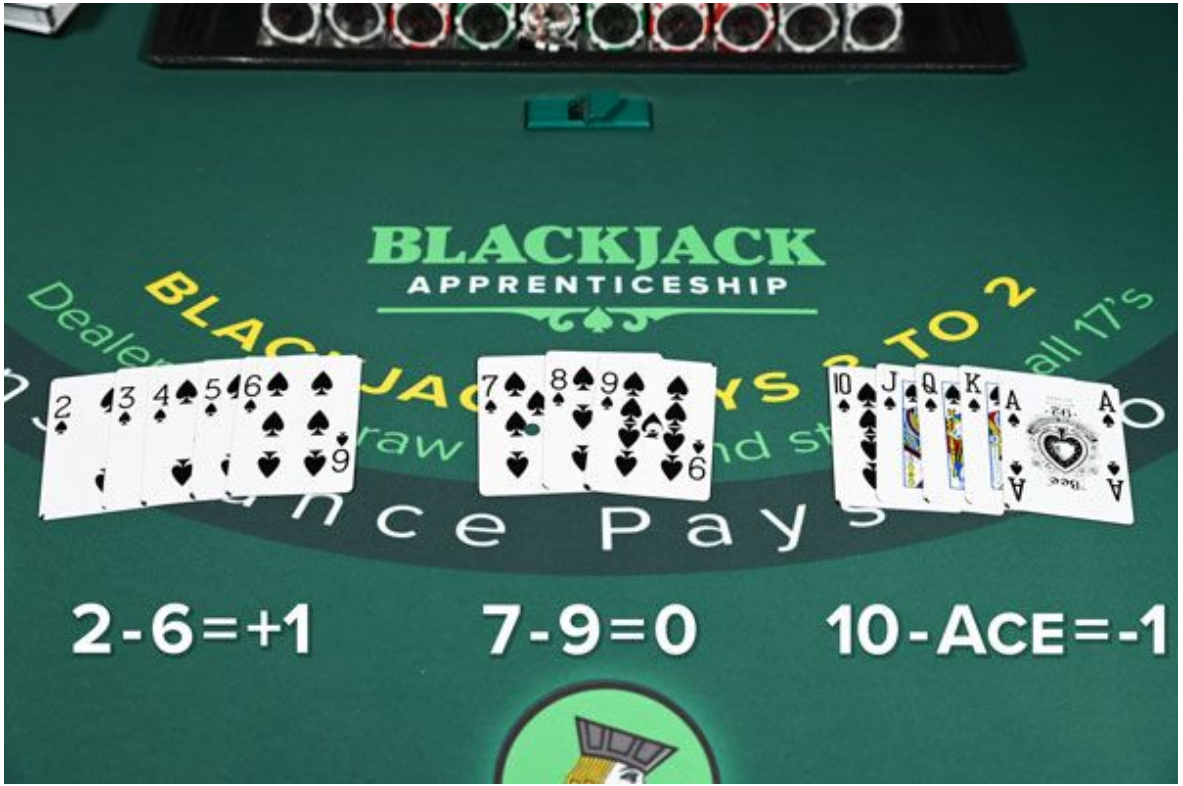
SPLIT 10'S
NEVERSPLIT10S.COM
ACKJACK PAYS 3-2
ST HIT ON SOFT
NSU AN

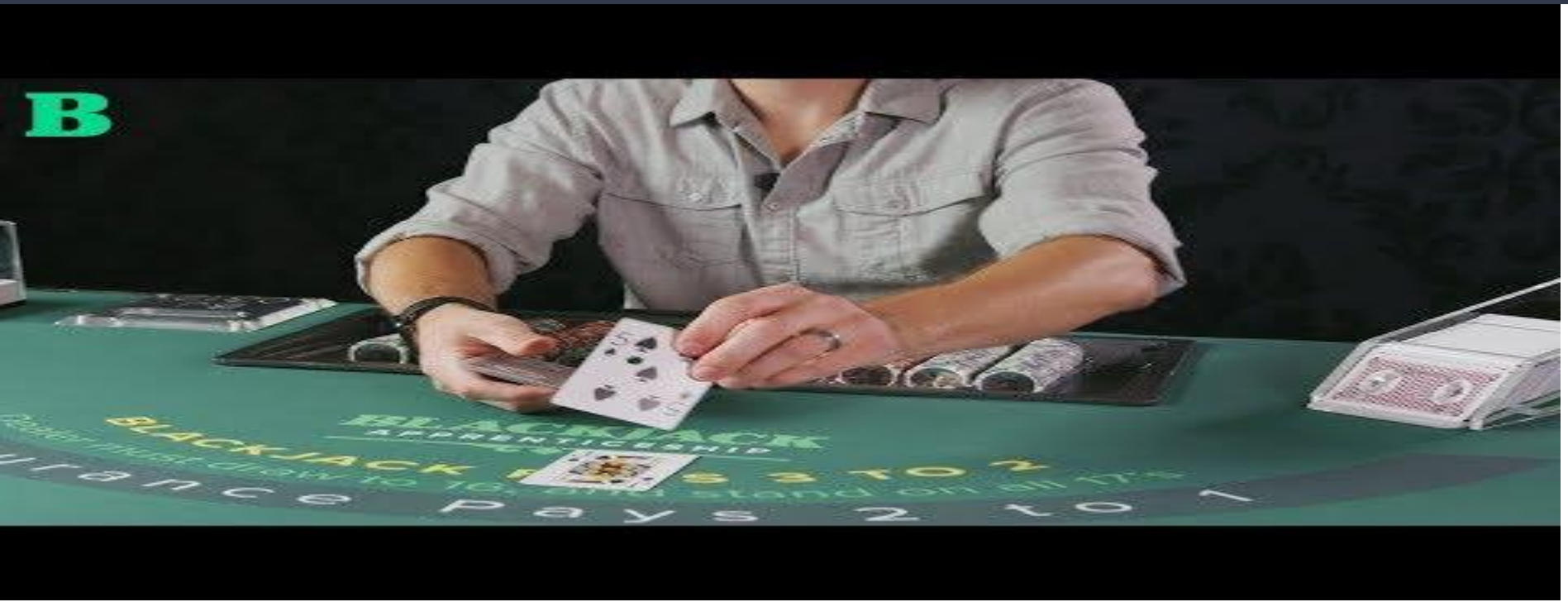
HISTORY OF BLACKJACK

- In 1956, THORP WITH HIS THREE COLLEAGUES, PUBLISHED THE OPTIMUM STRATEGY, BY EMPIRICAL TRIALS
- IN 1962, MATHEMATICS PROFESSOR, DR, EDWARD THORP WROTE BOOK "**BEAT THE DEALER**".
- AFTER BASIC STRATEGY, EVOLUTIONARY ALGORITHM WAS DEVELOPED WITH 3 MILLION SIMULATIONS
- THEN EVOLVED BASIC STRATEGY WAS INTRODUCED THAT OFFERED ADVANTAGE OF +0.218% TO PLAYER
- THEN COUNTING CARDS STRATEGY WAS INTRODUCED WHICH GIVES THE HIGHEST CHANCE TO WIN MONEY
- THE BASIC STRATEGY FOCUSES ON
  - TO MAXIMIZE PROFIT ON CONSISTENT HANDS
  - TO MINIMIZE LOSS IN THE LONG TERM

COUNTING CARDS:



EXAMPLE OF COUNTING CARDS:



TRUE COUNT:

TRUE COUNT = RUNNING COUNT / REMAINING NUMBER OF DECK OF CARDS

THIS TRUE COUNT HELPS TO MAKE A DECISION AS IT GIVES AN IDEA OF WHAT TYPE OF CARDS ARE GOING TO BE DEALT NEXT.

EVOLVED BASIC STRATEGY :

DEALER'S UPCARD										
YOUR HAND	2	3	4	5	6	7	8	9	10	A
12	H	H	S	S	S	H	H	H	H	H
13	S	S	S	S	S	H	H	H	H	H
14	S	S	S	S	S	H	H	H	H	H
15	S	S	S	S	S	H	H	H	H	H
16	S	S	S	S	S	H	H	H	H	H
17+	S	S	S	S	S	S	S	S	S	S
A2	H	H	D	D	D	H	H	H	H	H
A3	H	H	D	D	D	H	H	H	H	H
A4	H	H	D	D	D	H	H	H	H	H
A5	H	H	D	D	D	H	H	H	H	H
A6	D	D	D	D	D	H	H	H	H	H
A7	S	D	D	D	D	S	S	H	H	S
A8	S	S	S	D	D	S	S	S	S	S
A9	S	S	S	S	S	S	S	S	S	S

22	P	P	P	P	P	P	H	H	H	H
33	H	H	P	P	P	P	H	H	H	H
44	H	H	H	D	D	H	H	H	H	H
55	D	D	D	D	D	D	D	D	H	H
66	P	P	P	P	P	H	H	H	H	H
77	P	P	P	P	P	P	H	H	S	H
88	P	P	P	P	P	P	P	P	P	P
99	P	P	P	P	P	S	P	P	S	S
10 10	S	S	S	S	S	S	S	S	S	S
A A	P	P	P	P	P	P	P	P	P	P
5-7	H	H	H	H	H	H	H	H	H	H
8	H	H	H	D	D	H	H	H	H	H
9	D	D	D	D	D	H	H	H	H	H
10	D	D	D	D	D	D	D	D	H	H
11	D	D	D	D	D	D	D	D	D	D

H = HIT, S = STAND, D = DOUBLE DOWN, P = SPLIT
IF DOUBLING DOWN IS INDICATED AND PLAYER HAS MORE THAN TWO CARDS, THEN HIT
NEVER TAKE INSURANCE
STOP PLAYING WHEN RECEIVING A PAIR OF 9S OR WHEN TWO OR MORE ACES ARE DEALT IN A SINGLE ROUND

BASIC STRATEGY

BLACKJACK
APPRENTICESHIP

Basic Strategy is the first thing you need to know before you can start beating blackjack with card counting. Perfect Basic Strategy is what cuts the casinos' edge to a mere 0.5%, making it possible for you to gain an edge by counting cards.

PAIR SPLITTING

DEALER UPCARD

	2	3	4	5	6	7	8	9	10	A
A,A	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
T,T	N	N	N	N	N	N	N	N	N	N
9,9	Y	Y	Y	Y	Y	N	Y	Y	N	N
8,8	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
7,7	Y	Y	Y	Y	Y	Y	N	N	N	N
6,6	Y/N	Y	Y	Y	Y	N	N	N	N	N
5,5	N	N	N	N	N	N	N	N	N	N
4,4	N	N	N	Y/N	Y/N	N	N	N	N	N
3,3	Y/N	Y/N	Y	Y	Y	Y	N	N	N	N
2,2	Y/N	Y/N	Y	Y	Y	Y	N	N	N	N

KEY		
	Y	Split the Pair
	Y/N	Split if `Double After Split (DAS)` is offered, otherwise do not split
	N	Don't Split the Pair

SOFT TOTALS

	DEALER UPCARD									
	2	3	4	5	6	7	8	9	10	A
A,9	S	S	S	S	S	S	S	S	S	S
A,8	S	S	S	S	Ds	S	S	S	S	S
A,7	Ds	Ds	Ds	Ds	Ds	S	S	H	H	H
A,6	H	D	D	D	D	H	H	H	H	H
A,5	H	H	D	D	D	H	H	H	H	H
A,4	H	H	D	D	D	H	H	H	H	H
A,3	H	H	H	D	D	H	H	H	H	H
A,2	H	H	H	D	D	H	H	H	H	H

KEY		
	H	Hit
	S	Stand
	D	Double if allowed, otherwise hit
	Ds	Double if allowed, otherwise stand

HARD TOTALS

DEALER UPCARD

	2	3	4	5	6	7	8	9	10	A
17	S	S	S	S	S	S	S	S	S	S
16	S	S	S	S	S	H	H	H	H	H
15	S	S	S	S	S	H	H	H	H	H
14	S	S	S	S	S	H	H	H	H	H
13	S	S	S	S	S	H	H	H	H	H
12	H	H	S	S	S	H	H	H	H	H
11	D	D	D	D	D	D	D	D	D	D
10	D	D	D	D	D	D	D	D	H	H
9	H	D	D	D	D	H	H	H	H	H
8	H	H	H	H	H	H	H	H	H	H

KEY		
	H	Hit
	S	Stand
	D	Double if allowed, otherwise hit

LATE SURRENDER

DEALER UPCARD

	2	3	4	5	6	7	8	9	10	A
16								SUR	SUR	SUR
15									SUR	
14										

KEY		
	SUR	Surrender

INSURANCE OR EVEN MONEY: DON'T TAKE

Complexity Analysis

The complexity of the program is $O(n^2)$.
Where n is the number of players.

Execution time of the play() function

For n=1 players, t=5.00 sec.

For n=2 players, t=20.00 sec.

References

1) https://ieeexplore.ieee.org/document/1331064
   Author - D.B. Fogel
2) https://ieeexplore.ieee.org/document/1299399
   Author - G. Kendall & C. Smith
3) http://www.cplusplus.com/ (for pre-defined function used in the implementation).

THANK YOU

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