Written Requirements

Revision History

Authors	Description of Change	Sections	Rev	Date
S. Graham	Initial Attempt	All	O	3/20/2019
Hyun Woo Kim	Fill in missing information	All	O	3/24/2019
Brandon Lavello	Correcting Mistakes	All	O	3/25/2019
Josh Roberts	Adjustments	All	O	4/10/2019
Nick Bernstein	Added terminology	1	O	4/17/2019
Nick Bernstein	Added requirements	3	O	4/22/2019
Nick Bernstein	Added requirements	3	O	4/24/2019
Nick Bernstein	Added requirements	3	O	4/28/2019
Nick Bernstein	Recommended Revisions	All	A	4/30/2019

Table of Contents

1   Team Description

Team Member Name	Email Address
Nick Bernstein	skolyr@csu.fullerton.edu
Brandon Lavello	brandonlavello@csu.fullerton.edu
Josh Roberts	jroberts30@csu.fulleton.edu
Gregory Vasquez	gvasquez11@csu.fullerton.edu
Hyun Woo Kim	hyunwoo777@csu.fullerton.edu

2   Terminology
The following table defined terms used within this document.

Term	Definition
Client	Describes the program and its user interface
Game	Describes an entire game of Blackjack.
Round	Describes the total series of betting and dealing cards for each player at the table
Table	The collection of players both computer and user controlled
Deck	A standard deck of fifty two playing cards with four suits and 13 indices per suit
Shoe	A collection of between one and eight decks shuffled together.
Cut Card	A card placed in the shoe to signify when a new shoe must be generated.
Suit	separates the cards into four categories: Hearts, Diamonds, Spades and Clubs
Index	Used to identify the card within the suit categories: A, K Q, J, 10, 9, 8, 7, 6, 5, 4, 3, 2
Running Count	A value that is incremented or decremented based on cards dealt to indicate probability of drawing a certain class of card.
High Card	A class of cards that, when dealt, increment the running count
Low Card	A class of cards that, when dealt, decrement the running count
Neutral Card	A class of cards that, when dealt, do nothing to the running count
True Count	A value that enhances accuracy of the running count by dividing it by the number of remaining decks.
Player	A player or computer controlled entity at the table that performs actions.
Dealer	A computer controlled entity that the players are competing against.
Blackjack	When a player or dealer has a score of 21 after the first two cards have been dealt.
Decision	An action performed by the player when it is their turn.
Hole Card	The card dealt to the dealer face down.
Up Card	The card dealt to the dealer face up
Insurance	When the up card is an Ace, players may bet that the dealer has Blackjack.
Hand	The cards that belongs to a player or dealer
Value	The amount of points that specific cards apply to the score of a player or dealer
Ten Card	Any card with a value of 10.
Score	The sum of all card values of player's or dealer's has hand
Bank	The amount of money that a player has available to bet
Bet	Amount of the money a player gambles for that round
Hi-Lo	The abbreviation of the name of the card counting method used: High-Low
Game	Describes the entire game played. Ends when a player's bank reaches 0.
Round	Describes the event including the dealing and betting for all players
Turn	The event where a certain player is currently making decisions
Action	When it is a certain player's turn, they "have action" or are "with action"
Basic Strategy	A simple set of rules and associated actions that are recommended for specific scenarios for players that are not counting cards.
Soft	A hand score is soft if it contains an Ace that is being counted as 11 instead of 1.
Hard	A hand score is hard if it is not soft.
Push	When the player and the dealer scores are equivalent.

3   Card++

3.1   Overview

The Card++ is a training program which allows users to practice the technique of Hi-Lo card counting while playing the gambling game Blackjack by providing computer assisted, real-time tracking of the count for verification.

3.1.1   Game Parameters

RID – 1001: Card++ provides the ability to create and play a Blackjack card game.

RID – 1002: Card++ **shall** have a single dealer player.

RID – 1003: Card++ **shall** provide a shoe containing four to eight standard playing card decks.

RID – 1004: Card++ **shall** provide one to eight players that are either user or computer controlled.

RID – 1005: Card++ **shall** allow user to change parameters before a game has been started.

3.1.1.1   Default Parameters

Default parameters are as follows:

RID – 1006: Table has 4 players. Player 1 is user controlled. Players 2-4 are computer controlled.

RID – 1007: Starting Bank = $1,000.00

RID – 1008: Minimum Bet = $5.00

RID – 1009: Number of Decks in the shoe = 6

3.1.2   Start New Shoe

When a game is started, Card++ **shall** generate the following actions:

RID – 2001: generate a shoe with the designated number of decks.

RID – 2002: The shoe is shuffled (randomized).

RID – 2003: All players and the dealer are created with set parameters and placed at their position in the table.

RID – 2003: The running and true counts for the shoe are set to 0.

RID – 2004: A cut card is generated.

3.1.3   Game Play

RID – 3001: Each game consists of several rounds.

RID – 3002: Each round transitions through the following phases in this order unless otherwise specified:

a. Betting Phase
b. Initial Deal Phase
c. Dealer Blackjack Phase
d. Player Blackjack Phase
e. Normal Play Phase
f. Dealer Turn Phase
g. Pay Winnings Phase

RID – 3003: Each game ends when the shoe reaches the cut card or all players are out of money in their bank.

3.1.4 Betting Phase

The initial phase of each round is the Betting Phase.

RID – 4001: When the game enters the Betting Phase, Card++ **shall** ask the bet amount for each player.

RID – 4002: When all players have placed bets, Card++ **shall** transition into the Initial Deal Phase.

3.1.5 Initial Deal Phase

RID – 5001: When the game enters the Initial Deal Phase, Card++ **shall** deal card from the top of the shoe clockwise to each player starting with the player to the left of the dealer and ending with the dealer.

RID – 5002: The first card dealt to the dealer is marked as the hole card and hidden from the players and the counts.

RID – 5003: When every player has been dealt two cards, Card++ **shall** transition into the Dealer Blackjack Phase.

3.1.6 Dealer Blackjack Phase

The dealer automatically wins or pushes with players in the event they are dealt a Blackjack.

RID – 6001: If the up card is an Ace, Card++ **shall** offer Insurance to each player.

RID – 6002: If a player accepts Insurance, they place a separate bet equal to half of their starting bet.

RID – 6003: If the dealer has Blackjack, the round immediately transitions to the Pay Winnings Phase.

RID – 6003: If the dealer does not have Blackjack, Card++ **shall** transition into the Player Blackjack Phase.

3.1.7 Player Blackjack Phase

RID – 7001: If a Player has Blackjack, they automatically win that hand.

RID – 7002: If both the Player and the dealer have Blackjack, it is a push.

RID – 7003: If at least one player does not have Blackjack, Card++ **shall** transition into the Normal Play Phase.

RID – 7004: If all players have Blackjack, Card++ **shall** transition into the Pay Winnings Phase.

3.1.8 Normal Play Phase

RID – 8001: Action moves clockwise around the table, starting with the Player to the left of the dealer.

While in Normal Phase each Player is presented with the following decisions:

3.1.8.1   Stand

   RID – 8002: The player passes their turn to the next player.

3.1.8.2   Hit

   RID – 8003: The player is dealt the top card of the shoe.

   RID – 8004: If the player's hand score meets or exceeds 21, the player busts and action goes to the next hand/player.

3.1.8.3   Double Down

   RID – 8005: If the player has not been dealt any cards to this hand and they have enough money to match their current bet, they can receive one card from the top of the shoe and end their turn.

3.1.8.4   Split

RID – 8006: If the player has been dealt two cards with the same index and they have enough money to match their current bet, they can split their cards into two new hands.

RID – 8007: The first decision on a freshly split hand can include double down if player has the required bank balance.

RID – 8008: Each hand created from splitting is played separate from the others, with their own bet amounts and scores.

3.1.9   Dealer Turn Phase

RID – 9001: The dealer follows the following rules depending on their hand's score:

3.1.9.1   Soft 17

RID – 9002: If a dealer's hand is soft and less than or equal to 17, they must hit.

3.1.9.2   Hard 16

RID – 9003: If a dealer's hand is hard and less than or equal to 16, they must hit.

RID – 9004: The dealer repeats these actions until one of the above conditions is met.

3.1.10 Pay Winnings Phase

RID – 10001: If a player does not lose a bet, it is returned to their bank along with their winnings.

RID – 10002: After the Dealer ends their turn, the following payouts are made for each hand in play:

3.1.10.1 Dealer Blackjack

RID – 10003: If the Dealer had Blackjack at the start of the round, all players lose their starting bets unless they also have Blackjack.

RID – 10004: If a player took insurance, they are paid 2:1 on their insurance.

RID – 10005: If a player also has Blackjack, it is a push and they do not lose their starting bet.

3.1.10.2 Player Blackjack

RID – 10006: If the player has Blackjack and the dealer does not, they are paid 3:2 on their starting bet.

3.1.10.3 Equivalent Scores

RID – 10007: If the player's hand score is equal to the dealer's, it is a push and they do not lose their bet.

3.1.10.4 Dealer Loses

RID – 10008: If the player's hand score is greater than the dealer's, they are paid 1:1 on their bet.

3.1.10.5 Dealer Wins

RID – 10009: If the player's hand score is less than the dealer's, they lose their bet.

RID – 10010: Once all winnings are paid, Card++ **shall** start a new round and enter the Betting Phase.

3.1.11 Card Counting

As cards are dealt, the counts are updated. The true count is the running count divide by the remaining number of decks in the shoe.

RID – 11001: Card++ **shall** follow the Hi-Low Card Counting Method as defined below.

3.1.11.1 Hi-Lo Counting

RID – 11003: When a 2 through 6 is dealt, the running count is incremented by 1.

RID – 11004: When a J, Q, K, or A is dealt, the running count is decremented by 1.

RID – 11005: When a 7 through 9 is dealt, the running count does not change.

3.1.11.2 Recommended Bets

RID – 11006: If the true count is +1 or lower, Card++ **shall** recommend the minimum bet.

RID – 11007: If the true count is +2, Card++ **shall** recommend twice the minimum bet.

RID – 11008: If the true count is +3, Card++ **shall** recommend four times the minimum bet.

RID – 11009: If the true count is +4, Card++ **shall** recommend eight times the minimum bet.

RID – 11010: If the true count is +5, Card++ **shall** recommend twelve times the minimum bet.

3.1.11.3 Recommended Actions

RID – 11011: If the true count is +3 or higher, Card++ **shall** recommend the player take insurance.

Card++ **shall** recommend the player stand in the following scenarios at or above the specified count:

RID – 11012: If the player's hand score is 16, the up card is a 9 and the true count is +5.

RID – 11013: If the player's hand score is 16, the up card is a Ten Card and the true count is 0.

RID – 11014: If the player's hand score is 15, the up card is a Ten Card and the true count is +4.

RID – 11015: If the player's hand score is 13, the up card is a 2 and the true count is -1.

RID – 11016: If the player's hand score is 13, the up card is a 3 and the true count is -2.

RID – 11017: If the player's hand score is 12, the up card is a 2 and the true count is +4.

RID – 11018: If the player's hand score is 12, the up card is a 3 and the true count is +2.

RID – 11019: If the player's hand score is 12, the up card is a 4 and the true count is 0.

RID – 11020: If the player's hand score is 12, the up card is a 5 and the true count is -1.

RID – 11021: If the player's hand score is 12, the up card is a 6 and the true count is -1.

Card++ **shall** recommend the player double down in the following scenarios at or above the specified count:

RID – 11022: If the player's hand score is 11, the up card is an A and the true count is +1.

RID – 11023: If the player's hand score is 10, the up card is a Ten Card and the true count is +4.

RID – 11024: If the player's hand score is 10, the up card is an A and the true count is +4.

RID – 11025: If the player's hand score is 9, the up card is a 2 and the true count is +1.

RID – 11026: If the player's hand score is 9, the up card is a 7 and the true count is +1.

RID – 11026: Card++ **shall** recommend the player split two Ten Cards if the up card is a 5 or 6 and the true count is at or above +5.

RID – 11029: If a scenario is not specifically addressed, Card++ **shall** give recommendation based on Basic Strategy.

3.1.12 Basic Strategy

Recommendations based on Basic Strategy are from the following tables.

3.1.12.1 Hard Score

H = Hit   S = Stand   D = Double Down

Rows: The Player's hand score. Columns: The Up Card

	A	2	3	4	5	6	7	8	9	10	J	Q	K
4	H	H	H	H	H	H	H	H	H	H	H	H	H
5	H	H	H	H	H	H	H	H	H	H	H	H	H
6	H	H	H	H	H	H	H	H	H	H	H	H	H
7	H	H	H	H	H	H	H	H	H	H	H	H	H
8	H	H	H	H	H	H	H	H	H	H	H	H	H
9	H	H	D	D	D	D	H	H	H	H	H	H	H
10	H	D	D	D	D	D	D	D	D	H	H	H	H
11	D	D	D	D	D	D	D	D	D	D	D	D	D
12	H	H	H	S	S	S	H	H	H	H	H	H	H
13	H	S	S	S	S	S	H	H	H	H	H	H	H
14	H	S	S	S	S	S	H	H	H	H	H	H	H
15	H	S	S	S	S	S	H	H	H	H	H	H	H
16	H	S	S	S	S	S	H	H	H	H	H	H	H
17	S	S	S	S	S	S	S	S	S	S	S	S	S
18	S	S	S	S	S	S	S	S	S	S	S	S	S
19	S	S	S	S	S	S	S	S	S	S	S	S	S
20	S	S	S	S	S	S	S	S	S	S	S	S	S
21	S	S	S	S	S	S	S	S	S	S	S	S	S

3.1.12.2 Soft Score

H = Hit   S = Stand   D = Double Down

Rows: The Player's hand score. Columns: The Up Card

	A	2	3	4	5	6	7	8	9	10	J	Q	K
13	H	H	H	H	H	H	H	H	H	H	H	H	H
14	H	H	H	H	D	D	H	H	H	H	H	H	H
15	H	H	H	D	D	D	H	H	H	H	H	H	H
16	H	H	H	D	D	D	H	H	H	H	H	H	H
17	H	H	D	D	D	D	H	H	H	H	H	H	H
18	H	D	D	D	D	D	S	S	H	H	H	H	H
19	S	S	S	S	S	D	S	S	S	S	S	S	S
20	S	S	S	S	S	S	S	S	S	S	S	S	S
21	S	S	S	S	S	S	S	S	S	S	S	S	S

3.1.12.3 Duplicate Card Indices

H = Hit   S = Stand   D = Double Down   P = Split

Rows: The Player's hand.   Columns: The Up Card

	A	2	3	4	5	6	7	8	9	10	J	Q	K
A,A	P	P	P	P	P	P	P	P	P	P	P	P	P
2,2	H	P	P	P	P	P	P	H	H	H	H	H	H
3,3	H	P	P	P	P	P	P	H	H	H	H	H	H
4,4	H	H	H	H	P	P	H	H	H	H	H	H	H
5,5	H	D	D	D	D	D	D	D	D	H	H	H	H
6,6	H	P	P	P	P	P	H	H	H	H	H	H	H
7,7	H	P	P	P	P	P	P	H	H	H	H	H	H
8,8	P	P	P	P	P	P	P	P	P	P	P	P	P
9,9	S	P	P	P	P	P	S	P	P	S	S	S	S
10,10	S	S	S	S	S	S	S	S	S	S	S	S	S
J,J	S	S	S	S	S	S	S	S	S	S	S	S	S
Q,Q	S	S	S	S	S	S	S	S	S	S	S	S	S
K,K	S	S	S	S	S	S	S	S	S	S	S	S	S