## Introduction

For this demo, I will be demonstrating my game functionalities with seed 12. I will mention if I use another seeded game instance to highlight edge cases.

## Compile the Game

To start the game, navigate to the Straights folder and type the following command in your command line:

`make`

This should create the executable straights

```
c29wan@ubuntu2004-010:~/cs246/f21/Straights$ make
g++ -std=c++14 -Wall -MMD    -c -o Card.o Card.cc
g++ -std=c++14 -Wall -MMD    -c -o ComputerPlayer.o ComputerPlayer.cc
g++ -std=c++14 -Wall -MMD    -c -o Deck.o Deck.cc
g++ -std=c++14 -Wall -MMD    -c -o Game.o Game.cc
g++ -std=c++14 -Wall -MMD    -c -o HumanPlayer.o HumanPlayer.cc
g++ -std=c++14 -Wall -MMD    -c -o main.o main.cc
g++ -std=c++14 -Wall -MMD    -c -o Player.o Player.cc
g++ -std=c++14 -Wall -MMD    -c -o Subject.o Subject.cc
g++ -std=c++14 -Wall -MMD    -c -o Table.o Table.cc
g++ -std=c++14 -Wall -MMD    -c -o TableObserver.o TableObserver.cc
g++ -std=c++14 -Wall -MMD Card.o ComputerPlayer.o Deck.o Game.o HumanPlayer.o main.o Player.o
 Subject.o Table.o TableObserver.o -lX11 -o straights
```

## Start the Game

You can run the game with or without a seed argument.
To run the game without a seed, type the following command:

`./straights`

```
c29wan@ubuntu2004-010:~/cs246/f21/Straights$ ./straights
Is Player1 a human (h) or computer (c)?
>
```

To run the game with an integer seed, type the following command:

`./straights 12`

```
c29wan@ubuntu2004-010:~/cs246/f21/Straights$ ./straights 12
Is Player1 a human (h) or computer (c)?
>
```

Both commands should cause the game to prompt the user to specify player types.

If a user enters too many arguments, such as `./straights 12 12`, the program prints an error message and terminates the program:

```
c29wan@ubuntu2004-010:~/cs246/f21/Straights$ ./straights 12 12
You have entered too many arguments. Please enter 1 integer seed value or nothing
```

Initializing a Round

The program will now prompt you to specify whether each of the 4 players is a Computer or Human player. The only acceptable inputs are "h" or "c". Anything else inputted will result in the program printing an error message and re-prompting the user to enter a valid user type:

```
Is Player1 a human (h) or computer (c)?
>hh
Please enter a valid player type (h) or (c)
>sdfa
Please enter a valid player type (h) or (c)
>
Please enter a valid player type (h) or (c)
>hc
Please enter a valid player type (h) or (c)
>2
Please enter a valid player type (h) or (c)
>h
Is Player2 a human (h) or computer (c)?
>c
Is Player3 a human (h) or computer (c)?
>
```

For this demo, I will be assigning player 1 as a human, and the rest of the players as computers.

```
c29wan@ubuntu2004-010:~/cs246/f21/Straights$ ./straights 12
Is Player1 a human (h) or computer (c)?
>h
Is Player2 a human (h) or computer (c)?
>c
Is Player3 a human (h) or computer (c)?
>c
Is Player4 a human (h) or computer (c)?
>c
```

After the player assignments, the program will shuffle the deck once using the inputted seed value or a random seed value. 13 cards from the shuffled deck will be assigned to each player. A user can type the command deck to see what the deck for their current round is.

This is the deck for seed value 12, shuffled once:

```
>deck
2S 7H 7S 6S 6D 2H JC TS QH 4C 4S AS 8D
8C 9D 9C QS QC 4H 4D 2C 6C JH 7C KS KC
8H JS AD 3H AH KH 6H AC 3D JD 9S TH 3C
5H 5C 2D 5D 3S 9H 7D KD TC 8S TD 5S QD
```

Additionally, the program will also search for which player has the 7S card because they will go first. The program will prompt this user's turn to start. For seed value 12, Player1 has the 7S card so they will go first:

```
c29wan@ubuntu2004-010:~/cs246/f21/Straights$ ./straights 12
Is Player1 a human (h) or computer (c)?
>h
Is Player2 a human (h) or computer (c)?
>c
Is Player3 a human (h) or computer (c)?
>c
Is Player4 a human (h) or computer (c)?
>c
A new round begins. It's Player1's turn to play.
Cards on the table:
Clubs:
Diamonds:
Hearts:
Spades:
Your Hand: 2S 7H 7S 6S 6D 2H JC TS QH 4C 4S AS 8D
Legal plays: 7S
>
```

For example seed value 13, Player2 has the 7S card so they go first:

```
c29wan@ubuntu2004-010:~/cs246/f21/Straights$ ./straights 13
Is Player1 a human (h) or computer (c)?
>h
Is Player2 a human (h) or computer (c)?
>c
Is Player3 a human (h) or computer (c)?
>c
Is Player4 a human (h) or computer (c)?
>c
A new round begins. It's Player2's turn to play.
Cards on the table:
Clubs:
Diamonds:
Hearts:
Spades:
Your Hand: AD 4D 6H QH 2S KS 3C 3H 3S 7D 9S 8D 7S
Legal plays: 7S
>Player2 plays 7S.
```

Playing a turn

For each player at the start of their turn, the program will print the current cards that have been played as well as the player's current hand and their legal plays:

```
Cards on the table:
Clubs:
Diamonds:
Hearts:
Spades:
Your Hand: 2S 7H 7S 6S 6D 2H JC TS QH 4C 4S AS 8D
Legal plays: 7S
```

Computer Turn

A computer will automatically play the first legal play or discard the first card in their hand. The program will print the player's action and move on to the next player's turn. This example is where the first 3 players are computers, and the 4th player is human:

```
A new round begins. It's Player1's turn to play.
Cards on the table:
Clubs:
Diamonds:
Hearts:
Spades:
Your Hand: 2S 7H 7S 6S 6D 2H JC TS QH 4C 4S AS 8D
Legal plays: 7S
>Player1 plays 7S.
Cards on the table:
Clubs:
Diamonds:
Hearts:
Spades: 7
Your Hand: 8C 9D 9C QS QC 4H 4D 2C 6C JH 7C KS KC
Legal plays: 7C
>Player2 plays 7C.
Cards on the table:
Clubs: 7
Diamonds:
Hearts:
Spades: 7
Your Hand: 8H JS AD 3H AH KH 6H AC 3D JD 9S TH 3C
Legal plays:
>Player3 discards 8H.
```

Human Turn

For a human, the computer will prompt the player to enter one of the following 5 commands:

<mark>play <card></mark>
<mark>discard <card></mark>
<mark>deck</mark>
<mark>quit</mark>
<mark>ragequit</mark>

Invalid Command

If the player enters an invalid command that is not from the yellow list above, the program will print an error message and prompt the user for another command:

```
Cards on the table:
Clubs:
Diamonds:
Hearts:
Spades:
Your Hand: 2S 7H 7S 6S 6D 2H JC TS QH 4C 4S AS 8D
Legal plays: 7S
>doscard 8C
This is not a valid command
>test
This is not a valid command
>aosifdnsdf
This is not a valid command
>
```

Play Command

If the player tries to play a card not in their hand, the program will print an error message and prompt the user for another command:

```
Cards on the table:
Clubs:
Diamonds:
Hearts:
Spades:
Your Hand: 2S 7H 7S 6S 6D 2H JC TS QH 4C 4S AS 8D
Legal plays: 7S
>discard 2S
You have a legal play. You may not discard.
>play 5S
This is not a legal play.
```

If a player enters an invalid Card value for a play command, the program will prompt the user to reenter the command:

```
Your Hand: 2S 7H 7S 6S 6D 2H JC TS QH 4C 4S AS 8D
Legal plays: 7S
>play 3CC
This is not a legal play.
>play 44
This is not a legal play.
>
```

```
Your Hand: JS AD 3H AH KH 6H AC 3D JD 9S TH 3C
Legal plays: 6H
>play 6S
This is not a legal play.
>
```

If a player enters a valid play command, the program will register this and print their action:

```
Your Hand: 2S 7H 7S 6S 6D 2H JC TS QH 4C 4S AS 8D
Legal plays: 7S
>play 7S
Player1 plays 7S.
```

Discard Command

If the player has legal plays, it may not discard a card. The program will print an error message and prompt the user for another command:

```
Cards on the table:
Clubs:
Diamonds:
Hearts:
Spades:
Your Hand: 2S 7H 7S 6S 6D 2H JC TS QH 4C 4S AS 8D
Legal plays: 7S
>discard 2S
You have a legal play. You may not discard.
```

If a player enters an invalid Card value for a discard command, the program will prompt the user to reenter the command:

```
Your Hand: 8H JS AD 3H AH KH 6H AC 3D JD 9S TH 3C
Legal plays:
>discard AK
This is not a legal play.
>
```

If the player has no legal plays and tries to discard a card that isn't in their hand, the program will prompt the user to reenter the command:

```
Your Hand: 8H JS AD 3H AH KH 6H AC 3D JD 9S TH 3C
Legal plays:
>discard 8C
You do not own this card. You cannot discard.
```

If the player enters a valid discard command, the program will register this and prints their action:

```
Your Hand: 8H JS AD 3H AH KH 6H AC 3D JD 9S TH 3C
Legal plays:
>discard JS
Player3 discards JS.
```

Deck Command
If the player enters the deck command, the program will print the current deck for this round and prompt the user to enter a play again afterwards:

```
Cards on the table:
Clubs:
Diamonds:
Hearts:
Spades:
Your Hand: 2S 7H 7S 6S 6D 2H JC TS QH 4C 4S AS 8D
Legal plays: 7S
>deck
2S 7H 7S 6S 6D 2H JC TS QH 4C 4S AS 8D
8C 9D 9C QS QC 4H 4D 2C 6C JH 7C KS KC
8H JS AD 3H AH KH 6H AC 3D JD 9S TH 3C
5H 5C 2D 5D 3S 9H 7D KD TC 8S TD 5S QD
Your Hand: 2S 7H 7S 6S 6D 2H JC TS QH 4C 4S AS 8D
Legal plays: 7S
>
```

Quit Command

If a player enters quit, the program will exit successfully:

```
Your Hand: JS AD 3H AH KH AC 3D JD 9S TH 3C
Legal plays:
>quit
c29wan@ubuntu2004-010:~/cs246/f21/Straights$
```

Ragequit Command

My ragequit functionality does not work perfectly because it prints excess information. After switching to a computer player, it reprints "Your Hand:" and "Legal Plays:" before printing the computer's automated action.

```
Cards on the table:
Clubs:
Diamonds:
Hearts:
Spades: 7
Your Hand: 8C 9D 9C QS QC 4H 4D 2C 6C JH 7C KS KC
Legal plays: 7C
>ragequit
Player2 ragequits. A computer will now take over.
Your Hand: 8C 9D 9C QS QC 4H 4D 2C 6C JH 7C KS KC
Legal plays: 7C
>Player2 plays 7C.
Cards on the table:
```

Next Turn

After a player's turn, the next player's turn is prompted. In this case, player 2 is the only human player. For example, if player 3 just completed their turn, it would move to player 4's turn. Once player 4 completes their turn, it loops back to player 1's turn:

```
>Player3 discards 8H.
Cards on the table:
Clubs: 7
Diamonds:
Hearts:
Spades: 7
Your Hand: 5H 5C 2D 5D 3S 9H 7D KD TC 8S TD 5S QD
Legal plays: 7D 8S
>Player4 plays 7D.
Cards on the table:
Clubs: 7
Diamonds: 7
Hearts:
Spades: 7
Your Hand: 2S 7H 6S 6D 2H JC TS QH 4C 4S AS 8D
Legal plays: 7H 6S 6D 8D
>Player1 plays 7H.
Cards on the table:
Clubs: 7
Diamonds: 7
Hearts: 7
Spades: 7
Your Hand: 8C 9D 9C QS QC 4H 4D 2C 6C JH KS KC
Legal plays: 8C 6C
>
```

## End Round

This is the end of round 1 with 4 computer players. Once all players have either played or discarded their hand, the round ends and the results are printed:

```
>Player4 discards 9H.
Player1's discards: 2S QH AS
Player1's score: 0 + 15 = 15
Player2's discards: QS JH KS
Player2's score: 0 + 36 = 36
Player3's discards: 8H JS KH TH
Player3's score: 0 + 42 = 42
Player4's discards: 9H
Player4's score: 0 + 9 = 9
A new round begins. It's Player2's turn to play.
Cards on the table:
Clubs:
Diamonds:
Hearts:
Spades:
Your Hand: 8C JD 9D KH 4H 7C QD 4S 7S 3S 5C AH 9C
Legal plays: 7S
>
```

Afterwards, the Game settings are reset, meaning each player's hand and discard pile is cleared, the deck is shuffled once again with the rng, and the cards are redealt. If no one's scores are above 80, the game automatically restarts.

## End Game

The game ends when a player's total score at the end of a round exceeds 80. A game with seed 12 and 4 computer players has this final result:

```
Cards on the table:
Clubs: 3 4 5 6 7 8 9 J K Q T
Diamonds: 5 6 7
Hearts: 4 5 6 7 8 9 J K Q T
Spades: 3 4 5 6 7 8 9 J Q T
Your Hand: TD
Legal plays:
>Player4 discards TD.
Player1's discards: JD
Player1's score: 26 + 11 = 37
Player2's discards: 3H 2C 8D 4D 9D 2D AS
Player2's score: 54 + 29 = 83
Player3's discards: KS 3D QD AC
Player3's score: 79 + 29 = 108
Player4's discards: 2H AD KD 2S AH TD
Player4's score: 16 + 29 = 45
Player1 wins!
```

We can see that player 1 wins because 37 is the lowest discard score out of everyone. Additionally, we can see that in the previous round, player 3 had the highest score of 79, which is right below the required points of 80 to end the game.

Edge Cases Game Results

The minimum total score that a player can have is 0 points, meaning they played all of their cards. This occurs with seed 69 and 4 computer players:

```
Cards on the table:
Clubs: 2 3 4 5 6 7 8 9 A J T
Diamonds: 3 4 5 6 7 8 9 J Q T
Hearts: 5 6 7 8 9 J Q T
Spades: 2 3 4 5 6 7 8 9 A J K Q T
Your Hand: AD
Legal plays:
>Player2 discards AD.
Player1's discards: 4H QC KC
Player1's score: 53 + 29 = 82
Player2's discards: KD 2H AD
Player2's score: 38 + 16 = 54
Player3's discards: KH AH
Player3's score: 59 + 14 = 73
Player4's discards: 2D 3H
Player4's score: 36 + 5 = 41
Player4 wins!
```

It is possible for more than 1 player to win if they tie for lowest score. For seed 40 and 4 computer players, there are 2 winners because both player 2 and player 3 have a score of 43.

```
>Player1 discards 3H.
Player1's discards: 5H AH 3H
Player1's score: 39 + 9 = 48
Player2's discards: JH 9H 3D 4H QH
Player2's score: 4 + 39 = 43
Player3's discards: JS 2H AD KS
Player3's score: 16 + 27 = 43
Player4's discards: TH QS KH 2D
Player4's score: 57 + 37 = 94
Player2 wins!
Player3 wins!
```

Another example of this is with game seed 25 and 4 computer players:

```
Cards on the table:
Clubs: 6 7 8 9 J Q T
Diamonds: 2 3 4 5 6 7 8 9 J K Q T
Hearts: 2 3 4 5 6 7 8 9 A J K Q T
Spades: 2 3 4 5 6 7 8 9 A
Your Hand: TS
Legal plays: TS
>Player3 plays TS.
Player1's discards: 2C AD KS 5C AC
Player1's score: 10 + 22 = 32
Player2's discards: KC 3C JS
Player2's score: 67 + 27 = 94
Player3's discards: 4C QS
Player3's score: 16 + 16 = 32
Player4's discards:
Player4's score: 37 + 0 = 37
Player1 wins!
Player3 wins!
```

An edge case also occurs when a player has exactly 80 points, causing the game to end. This occurs with game seed 52 and 4 computer players:

```
Cards on the table:
Clubs: 2 3 4 5 6 7 8 9 A J K Q T
Diamonds: 6 7 8
Hearts: 3 4 5 6 7 8 9 J K Q T
Spades: 2 3 4 5 6 7 8 9 A J K Q T
Your Hand: AD
Legal plays:
>Player4 discards AD.
Player1's discards: AH
Player1's score: 79 + 1 = 80
Player2's discards: TD 9D 5D QD
Player2's score: 51 + 36 = 87
Player3's discards: 2H 3D 2D JD KD
Player3's score: 63 + 31 = 94
Player4's discards: 4D AD
Player4's score: 60 + 5 = 65
Player4 wins!
```