How to use it

Command-line:

```
$ ./straights -a --players=2 1
```

The program is called "straights". It has the following options and arguments
- "-a"
    - Including this will enable "advanced" AI
    - Originally computer players will have the normal, simple AI detailed in the project guidelines
    - Once a player "rage quits," the computer player that takes its place will have a different, smarter AI from the rest
- "--players=[number of players]"
    - Setting this and replacing "[number of players]" with a positive integer, you start a game with only "[number of players]" players instead of the default 4 when included
    - In the example shown above, "--players=2" will result in there only being 2 players
    - Cards are still distributed evenly among the players (when there are 2 players, they get 26 cards instead of the usual 13 with 4 players, for example)
- "[seed]"
    - Having a number as an argument (any number of numbers) will take the last number to be the "seed" of the game
    - Games will shuffle in a way that the decks will be equal provided they have the same seed

All of the configuration mentioned above is optional. Calling "./straights" will start a base game as outlined in the project guidelines with a random seed.

```
Program is used as follows: ./straights <options> <seed>
Optional parameters:
        <options>:
                --players=[number (POSITIVE INTEGER) of players]
                -a (enables advanced bots to replace ragequitters)
        <seed>:
                [seed (INTEGER) for pseudo-shuffling of deck]
```

This is simply output from when you use invalid arguments.

Pre-game Inputs

Before the game begins, you will be prompted to declare which players will start as humans and which will start as computers. Input "h" for humans or "c" for computers.

```
Is Player 1 a human (h) or a computer (c)?
h
Is Player 2 a human (h) or a computer (c)?
c
```

In the image above, Player 1 is a human and will expect inputs from a user. Player 2 is a computer and will move on its own.

```
Is Player 3 a human (h) or a computer (c)?
a
Not a valid answer.
Is Player 3 a human (h) or a computer (c)?
```

If you don't put either, you will have to pick for that player again, as shown above.

Game Inputs

The inputs are exactly as specified in the project guidelines, shown below.

Command	Description

`play <card>`	Play the specified card. You may assume that the `<card>` has valid syntax (i.e., `<rank><suit>`, such as 7C), and that the specified card is in the player's hand. However, it might not be a legal play.
	
	If the play is legal, print:
	
	`Player<x> plays <card>.`
	
	and proceed to the next player. Otherwise, print:
	
	`This is not a legal play.`
	`>`
	
	and do not proceed to the next player until a legal play is made.

`discard <card>`	If the player has no legal plays, discard the specified card from the player's hand into the player's discard pile. Again, assume that the `<card>` has valid syntax and that the `<card>` is in the player's hand. For test purposes, the value of the card is printed even though that deviates from the normal straights game play.
	
	`Player <x> discards <card>.`
	
	Otherwise, print the following error message:
	
	`You have a legal play. You may not discard.`
	`>`

`deck`	Print the contents of the deck in order, 13 cards per line. For example:
	
	`TS 2D 3S KH 3H 2C 5D TC 8S TD AC KC QH`
	`4D JH 6H JC KD 8C 7D TH 4H 9S 6S 4S KS`
	`7S 7C QD 6C 2H 6D 3C 9C 5H 3D AD 5S 8H`
	`QC 2S 8D JS QS AS JD 4C 7H 9D 5C AH 9H`
	`>`
	
	(This command is not part of the straights game. It is provided to help both you and us with the testing and debugging of your program.)

`quit`	Terminate the program immediately.
`ragequit`	Filled with anger, a human player decides to leave! Print the following message: `Player <x> ragequits. A computer will now take over.` Replace the current human player with a computer player, and resume the game.

"<card>" is the string representation of the card you wish to target. The ranks are as follows:
- A for ace
- 2 to 9
- T for 10
- J for Jack
- Q for Queen
- K for King

The suites are as follows:
- C for clubs
- D for diamonds
- H for hearts
- S for spades

For example, if you wish to play the 7 of spades, you type "play 7S", where "7S" represents your 7 of spades.

The Base Game In Action

Basic play

Let us proceed with the following game unless otherwise shown (in the same image):

```
jm251i@ubuntu2004-014:~/cs246/f21/final$ ./straights --players=1
Is Player 1 a human (h) or a computer (c)?
h
```

We are presented with the following:

```
jm251i@ubuntu2004-014:~/cs246/f21/final$ ./straights --players=1
Is Player 1 a human (h) or a computer (c)?
h
Shuffling deck and re-distributing hands.
It's Player 1's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades:
Your hand: 8S 9C QH TS TH 6D 7C 6C KH TC JS 3S 4D AH 2H 3C 2S 8D 9S JH 4C 8H
 8C KS 5H 4H QD QC 7S TD 3D AS 9H JC KD 9D KC 6H QS 6S 5D 7H AC 4S 2D 5C 3H
5S AD 7D JD 2C
Legal plays: 7S
Move?:
```

The first card that must be played is 7S.

```
It's Player 1's turn to play.
Cards on the table:
     Clubs:
 Diamonds:
    Hearts:
    Spades:
Your hand: KS 6D 8S AD 3C QD 4D 7D KC QS 7H 5H 3S TS 7C 8H 7S 9C JS 5S JC QC
 2H TH 8D TC 6H 5C 4C 6C 5D AC 6S 3H 2S JH 2D 4S TD 9H AH 8C QH KD 9S JD KH
9D AS 4H 2C 3D
Legal plays: 7S
Move?:
play KS
Play is invalid. Try again.
discard KS
Play is invalid. Try again.
discard 7S
Play is invalid. Try again.
play 7S
Player 1 plays card 7S.
It's Player 1's turn to play.
Cards on the table:
     Clubs:
 Diamonds:
    Hearts:
    Spades: 7
Your hand: KS 6D 8S AD 3C QD 4D 7D KC QS 7H 5H 3S TS 7C 8H 9C JS 5S JC QC 2H
 TH 8D TC 6H 5C 4C 6C 5D AC 6S 3H 2S JH 2D 4S TD 9H AH 8C QH KD 9S JD KH 9D
AS 4H 2C 3D
Legal plays: 6S 8S 7C 7D 7H
Move?:
```

Notice that if we have a legal play, we can't play other cards, nor can we discard any card. If we make a bad move, we have to try again until we make a valid move. Once we made a valid move, we notice that 7 of spades is now on the table, "7S" is no longer in our hand, and the legal plays list has been updated to show all the cards we can play from our hand.

If we signal end-of-file, or type "quit", the game will end.

```
It's Player 1's turn to play.
Cards on the table:
     Clubs:
 Diamonds:
    Hearts:
    Spades: 7
Your hand: KS 6D 8S AD 3C QD 4D 7D KC QS 7H 5H 3S TS 7C 8H 9C JS 5S JC QC 2H
 TH 8D TC 6H 5C 4C 6C 5D AC 6S 3H 2S JH 2D 4S TD 9H AH 8C QH KD 9S JD KH 9D
AS 4H 2C 3D
Legal plays: 6S 8S 7C 7D 7H
Move?:
quit
The game has come to an end.
Points are as follows
 - Player 1: 0pts
And the WINNERS are:
Player 1 wins!
jm25li@ubuntu2004-014:~/cs246/f21/final$
```

```
Move?:
The game has come to an end.
Points are as follows
 - Player 1: 0pts
And the WINNERS are:
Player 1 wins!
jm25li@ubuntu2004-014:~/cs246/f21/final$
```

The image immediately above shows what happens when an end-of-file is signaled.

Let's now observe the following game with a seed of 1.

```
jm25li@ubuntu2004-014:~/cs246/f21/final$ ./straights 1
Is Player 1 a human (h) or a computer (c)?
h
Is Player 2 a human (h) or a computer (c)?
c
Is Player 3 a human (h) or a computer (c)?
h
Is Player 4 a human (h) or a computer (c)?
c
Shuffling deck and re-distributing hands.
It's Player 4's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades:
Your hand: 4D 5H KC 3C QH 7S KS 5C 5D 3S QD QC JS
Legal plays: 7S
Move?:
Player 4 plays card 7S.
It's Player 1's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 7
Your hand: 9H 8C TH 2H JD 9D 2C TD 6C 9S 4H 6H AH
Legal plays:
Move?:
```

Players of even numbers are computers while odd numbers are human. Notice that the game didn't automatically start on player 1. Instead, it started on the player who possessed 7S, in this case player 4. We'll look more into the computer's AI later. But for now, let's focus on the legal plays. We see that on player 1's turn, the only valid moves would be any spade with ranks adjacent to 7 (6S or 8S), or any of the other 7's (7C, 7D, and 7H). Player 1 doesn't have any of those cards, so they don't appear as legal plays player 1 can make.

```
Move?:
play 6S
Play is invalid. Try again.
play 7H
Play is invalid. Try again.
play 7D
Play is invalid. Try again.
play 7S
Play is invalid. Try again.
```

None of those can be played. We even threw in a card that didn't exist and got caught. Our only play here is to discard a card.

```
discard 6S
Play is invalid. Try again.
discard 9H
Player 1 discards a card.
It's Player 2's turn to play.
```

We can't discard a card that isn't in our hand, so we discard some card, 9H in this case. Now the came can continue.

```
It's Player 2's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 7
Your hand: 8S TC 5S 8H JC AS 3H 7D 2S 9C KD TS 7C
Legal plays: 8S 7C 7D
Move?:
Player 2 plays card 8S.
It's Player 3's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 7 8
Your hand: KH 4C 6D JH 8D 2D 6S AC 7H QS AD 3D 4S
Legal plays: 6S 7H
Move?:
```

After player 2 has completed its turn, we see that unlike player 1, player 3 has legal plays. These are cards that can be played and are in player 3's hand.

```
Move?:
discard AC
Play is invalid. Try again.
discard 7H
Play is invalid. Try again.
play 7H
Player 3 plays card 7H.
It's Player 4's turn to play.
```

Again, we have to make a legal play if it is available. We can't let player 3 discard when legal plays are available, and we can't discard those legal plays. So, we have player 3 make a legal play.

```
It's Player 4's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts: 7
   Spades: 7 8
Your hand: 4D 5H KC 3C QH KS 5C 5D 3S QD QC JS
Legal plays:
Move?:
Player 4 discards a card.
It's Player 1's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts: 7
   Spades: 7 8
Your hand: 8C TH 2H JD 9D 2C TD 6C 9S 4H 6H AH
Legal plays: 9S 6H
Move?:
```

Thus the game continues.

Seed and Card Order

Before looking at the computer players, let's peek at the deck and its shuffling in progress.

```
jm25li@ubuntu2004-014:~/cs246/f21/final$ echo 1
1
jm25li@ubuntu2004-014:~/cs246/f21/final$ ./straights 1
Is Player 1 a human (h) or a computer (c)?
h
Is Player 2 a human (h) or a computer (c)?
h
Is Player 3 a human (h) or a computer (c)?
h
Is Player 4 a human (h) or a computer (c)?
h
Shuffling deck and re-distributing hands.
It's Player 4's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades:
Your hand: 4D 5H KC 3C QH 7S KS 5C 5D 3S QD QC JS
Legal plays: 7S
Move?:
deck
9H 8C TH 2H JD 9D 2C TD 6C 9S 4H 6H AH
8S TC 5S 8H JC AS 3H 7D 2S 9C KD TS 7C
KH 4C 6D JH 8D 2D 6S AC 7H QS AD 3D 4S
4D 5H KC 3C QH 7S KS 5C 5D 3S QD QC JS
```

As proof, I've echoed 1 before starting the program. With a seed of 1, the deck at the beginning of round 1 is in the order it appears after we declare the move "deck".

```
Player 3 discards a card.
No more cards to be played.
Player 1's discards:   9H 8C TH 2H 2C AH 4H
Player 1's score: 0 + 36 = 36
Player 2's discards:   TC JC 3H 9C
Player 2's score: 0 + 33 = 33
Player 3's discards:   KH 4C JH 2D AC AD 3D
Player 3's score: 0 + 35 = 35
Player 4's discards:   4D 5H KC 3C QH QC
Player 4's score: 0 + 49 = 49
A new round begins!
Shuffling deck and re-distributing hands.
It's Player 4's turn to play.
Cards on the table:
      Clubs:
  Diamonds:
     Hearts:
     Spades:
Your hand: 8S AS 3S 6C 5C 4C JS 8H JC 6H KS 7S QH
Legal plays: 7S
Move?:
Player 4 plays card 7S.
It's Player 1's turn to play.
Cards on the table:
      Clubs:
  Diamonds:
     Hearts:
     Spades: 7
Your hand: 7H 6D 4S 2C KC AC JD 3D 7D QS TC 9C TH
Legal plays: 7D 7H
Move?:
deck
7H 6D 4S 2C KC AC JD 3D 7D QS TC 9C TH
2D AD 3H 8D 5H 2H 4H 7C TD 6S QD 4D TS
QC AH 2S 3C JH 9D KD 9H KH 5D 8C 9S 5S
8S AS 3S 6C 5C 4C JS 8H JC 6H KS 7S QH
```

As the second round starts, it reshuffles and redistributes hands. I've rage quitted player 1-3, but here we can also see what happens at the end of a round.

When player 3 discards the last card in their hand, the game goes back to the starting player, player 4. However, nobody has cards left. Thus the round ends. The game announces, "No more cards to be played." Each players discard piles are shown and theirs round's discard scores are added to their game's discard score prior to the round beginning (0 because this is the first round). A new round begins, shuffling the deck and giving each player a new hand. Player 4 starts again coincidently, and they do have 7S. Notice that their hand is different. Also notice that the deck is different this time as we've taken the deck order from the beginning of the previous round and shuffled it again from that point. This is repeatable with the same seed as shown below.

```
jm25li@ubuntu2004-014:~/cs246/f21/final$ echo 2
2
jm25li@ubuntu2004-014:~/cs246/f21/final$ ./straights 1
Is Player 1 a human (h) or a computer (c)?
h
Is Player 2 a human (h) or a computer (c)?
h
Is Player 3 a human (h) or a computer (c)?
c
Is Player 4 a human (h) or a computer (c)?
c
Shuffling deck and re-distributing hands.
It's Player 4's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades:
Your hand: 4D 5H KC 3C QH 7S KS 5C 5D 3S QD QC JS
Legal plays: 7S
Move?:
Player 4 plays card 7S.
It's Player 1's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 7
Your hand: 9H 8C TH 2H JD 9D 2C TD 6C 9S 4H 6H AH
Legal plays:
Move?:
deck
9H 8C TH 2H JD 9D 2C TD 6C 9S 4H 6H AH
8S TC 5S 8H JC AS 3H 7D 2S 9C KD TS 7C
KH 4C 6D JH 8D 2D 6S AC 7H QS AD 3D 4S
4D 5H KC 3C QH 7S KS 5C 5D 3S QD QC JS
```

```
Player 3 discards a card.
No more cards to be played.
Player 1's discards:  9H 8C TH 2H 2C AH 4H
Player 1's score: 0 + 36 = 36
Player 2's discards:  TC JC 3H 9C
Player 2's score: 0 + 33 = 33
Player 3's discards:  KH 4C JH 2D AC AD 3D
Player 3's score: 0 + 35 = 35
Player 4's discards:  4D 5H KC 3C QH QC
Player 4's score: 0 + 49 = 49
A new round begins!
Shuffling deck and re-distributing hands.
It's Player 4's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades:
Your hand: 8S AS 3S 6C 5C 4C JS 8H JC 6H KS 7S QH
Legal plays: 7S
Move?:
Player 4 plays card 7S.
It's Player 1's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 7
Your hand: 7H 6D 4S 2C KC AC JD 3D 7D QS TC 9C TH
Legal plays: 7D 7H
Move?:
deck
7H 6D 4S 2C KC AC JD 3D 7D QS TC 9C TH
2D AD 3H 8D 5H 2H 4H 7C TD 6S QD 4D TS
QC AH 2S 3C JH 9D KD 9H KH 5D 8C 9S 5S
8S AS 3S 6C 5C 4C JS 8H JC 6H KS 7S QH
```

Even with different starting states (I threw in some computers this time), we get the same deck states and the same hands.

With a different seed, of course, we end up with a different deck order.

```
jm25li@ubuntu2004-014:~/cs246/f21/final$ ./straights 2
Is Player 1 a human (h) or a computer (c)?
h
Is Player 2 a human (h) or a computer (c)?
c
Is Player 3 a human (h) or a computer (c)?
c
Is Player 4 a human (h) or a computer (c)?
c
Shuffling deck and re-distributing hands.
It's Player 2's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades:
Your hand: 2S TD 4H JH 4C 2H 9S 5H 6S QS 2C 7S 3D
Legal plays: 7S
Move?:
Player 2 plays card 7S.
It's Player 3's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 7
Your hand: 8S 6C TC 8C 7H 5D AS KC JC AD 4D 7D KS
Legal plays: 8S 7D 7H
Move?:
Player 3 plays card 8S.
It's Player 4's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 7 8
Your hand: AH QH 3S 7C 6D TS 9H KD 3C 5S 6H JS 4S
Legal plays: 7C
Move?:
Player 4 plays card 7C.
It's Player 1's turn to play.
Cards on the table:
    Clubs: 7
 Diamonds:
   Hearts:
   Spades: 7 8
Your hand: QD 8H KH 8D 3H TH 5C 2D QC JD 9D 9C AC
Legal plays:
Move?:
deck
QD 8H KH 8D 3H TH 5C 2D QC JD 9D 9C AC
2S TD 4H JH 4C 2H 9S 5H 6S QS 2C 7S 3D
8S 6C TC 8C 7H 5D AS KC JC AD 4D 7D KS
AH QH 3S 7C 6D TS 9H KD 3C 5S 6H JS 4S
```

Computerization

Now let's finally look at the bots included in this game.

```
jm25li@ubuntu2004-014:~/cs246/f21/final$ ./straights --players=2 1
Is Player 1 a human (h) or a computer (c)?
h
Is Player 2 a human (h) or a computer (c)?
c
Shuffling deck and re-distributing hands.
It's Player 2's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades:
Your hand: KH 4C 6D JH 8D 2D 6S AC 7H QS AD 3D 4S 4D 5H KC 3C QH 7S KS 5C 5D 3S QD QC JS
Legal plays: 7S
Move?:
Player 2 plays card 7S.
It's Player 1's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 7
Your hand: 9H 8C TH 2H JD 9D 2C TD 6C 9S 4H 6H AH 8S TC 5S 8H JC AS 3H 7D 2S 9C KD TS 7C
Legal plays: 8S 7C 7D
Move?:
```

We initially have player 1 as a human and player 2 as a bot or computer player. The bot automatically performs its moves when it is its turn. Bots follow all the rules human players have to follow; bots must play a legal card if they have legal plays, and a bot can only discard if they don't have a legal play.

```
It's Player 1's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 7
Your hand: 9H 8C TH 2H JD 9D 2C TD 6C 9S 4H 6H AH 8S TC 5S 8H JC AS 3H 7D 2S 9C KD TS 7C
Legal plays: 8S 7C 7D
Move?:
ragequit
Player 1 plays card 8S.
It's Player 2's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 7 8
Your hand: KH 4C 6D JH 8D 2D 6S AC 7H QS AD 3D 4S 4D 5H KC 3C QH KS 5C 5D 3S QD QC JS
Legal plays: 6S 7H
Move?:
Player 2 plays card 6S.
It's Player 1's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 6 7 8
Your hand: 9H 8C TH 2H JD 9D 2C TD 6C 9S 4H 6H AH TC 5S 8H JC AS 3H 7D 2S 9C KD TS 7C
Legal plays: 7C 7D 9S 5S
Move?:
Player 1 plays card 9S.
```

When a player rage quits, a bot will take their place. The first move player 1 makes here is "ragequit". Immediately, the bot that took player 1's place plays 8C. Then the 2 bots go back and forth with their turns. Just as was specified in the project guidelines, these unenhanced bots play the leftmost card in their hand that is legal, and will discard the leftmost card if if there are none that are legal. An example of discarding is shown below from the same game in the same round.

```
It's Player 2's turn to play.
Cards on the table:
    Clubs: 5 6 7 8 9 T J Q
 Diamonds: 7
   Hearts: A 2 3 4 5 6 7 8 9 T J Q
   Spades: A 2 3 4 5 6 7 8 9 T J
Your hand: 5D QD
Legal plays:
Move?:
Player 2 discards a card.
It's Player 1's turn to play.
Cards on the table:
    Clubs: 5 6 7 8 9 T J Q
 Diamonds: 7
   Hearts: A 2 3 4 5 6 7 8 9 T J Q
   Spades: A 2 3 4 5 6 7 8 9 T J
Your hand: TD KD
Legal plays:
Move?:
Player 1 discards a card.
It's Player 2's turn to play.
Cards on the table:
    Clubs: 5 6 7 8 9 T J Q
 Diamonds: 7
   Hearts: A 2 3 4 5 6 7 8 9 T J Q
   Spades: A 2 3 4 5 6 7 8 9 T J
Your hand: QD
Legal plays:
Move?:
Player 2 discards a card.
It's Player 1's turn to play.
Cards on the table:
    Clubs: 5 6 7 8 9 T J Q
 Diamonds: 7
   Hearts: A 2 3 4 5 6 7 8 9 T J Q
   Spades: A 2 3 4 5 6 7 8 9 T J
Your hand: KD
Legal plays:
Move?:
Player 1 discards a card.
No more cards to be played.
Player 1's discards:  JD 9D 2C TD KD
Player 1's score: 0 + 45 = 45
Player 2's discards:  KH 4C 6D 8D 2D AC QS AD 3D 4D KC 3C KS 5D QD
Player 2's score: 0 + 100 = 100
The game has come to an end.
Points are as follows
 - Player 1: 45pts
 - Player 2: 100pts
And the WINNERS are:
Player 1 wins!
jm251i@ubuntu2004-014:~/cs246/f21/final$
```

The bot plays can discard cards from their hand, having the same effects a human player would

have to their discard totals and to the state of the game. Also see how the game ends at the end of the round, and not the middle. Unlike previous examples in *Seed and Card Order*, a player's score surpassed the 80 score threshold, thus ending the game. The bot(s) with the lowest score wins, and their discard piles are in order. Let's keep looking at this.

Game Ends

As we've seen in the examples above, calling "quit" or signaling end-of-file can end the game, announcing the appropriate winner and the discard totals accumulated per player the entire game. We've also seen how games can only end naturally at the end of a round, now in the middle, and only when a player has surpassed 80 points. Here is an example of a game that ended after multiple rounds.

```
jm251i@ubuntu2004-014:~/cs246/f21/final$ ./straights 1
Is Player 1 a human (h) or a computer (c)?
c
Is Player 2 a human (h) or a computer (c)?
c
Is Player 3 a human (h) or a computer (c)?
c
Is Player 4 a human (h) or a computer (c)?
c
```

End of round 1

```
Player 3 discards a card.
No more cards to be played.
Player 1's discards:  9H 8C TH 2H 2C 4H AH
Player 1's score: 0 + 36 = 36
Player 2's discards:  TC JC 3H 9C
Player 2's score: 0 + 33 = 33
Player 3's discards:  KH 4C JH 2D AC AD 3D
Player 3's score: 0 + 35 = 35
Player 4's discards:  4D 5H KC 3C QH QC
Player 4's score: 0 + 49 = 49
A new round begins!
Shuffling deck and re-distributing hands.
It's Player 4's turn to play.
```

End of round 2

```
Player 3 discards a card.
No more cards to be played.
Player 1's discards:  KC QS
Player 1's score: 36 + 25 = 61
Player 2's discards:
Player 2's score: 33 + 0 = 33
Player 3's discards:  QC AH 2S
Player 3's score: 35 + 15 = 50
Player 4's discards:  AS 3S JS KS
Player 4's score: 49 + 28 = 77
A new round begins!
Shuffling deck and re-distributing hands.
It's Player 3's turn to play.
```

End of round 3

```
Player 2 plays card 3D.
No more cards to be played.
Player 1's discards:  AD
Player 1's score: 61 + 1 = 62
Player 2's discards:  AS
Player 2's score: 33 + 1 = 34
Player 3's discards:
Player 3's score: 50 + 0 = 50
Player 4's discards:  2D 2H AH
Player 4's score: 77 + 5 = 82
The game has come to an end.
Points are as follows
 - Player 1: 62pts
 - Player 2: 34pts
 - Player 3: 50pts
 - Player 4: 82pts
And the WINNERS are:
Player 2 wins!
jm251i@ubuntu2004-014:~/cs246/f21/final$
```

As demonstrated, points carry over from previous rounds appropriately, the discard pile starts anew with every round, and the game only ends once a player surpasses the 80 point threshold.

Also, if the game ends abruptly, the player(s) with the lowest points wins.

```
jm251i@ubuntu2004-014:~/cs246/f21/final$ ./straights --players=2 1
Is Player 1 a human (h) or a computer (c)?
h
Is Player 2 a human (h) or a computer (c)?
h
Shuffling deck and re-distributing hands.
It's Player 2's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades:
Your hand: KH 4C 6D JH 8D 2D 6S AC 7H QS AD 3D 4S 4D 5H KC 3C QH 7S KS 5C 5D 3S QD QC JS
Legal plays: 7S
Move?:
play 7S
Player 2 plays card 7S.
It's Player 1's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 7
Your hand: 9H 8C TH 2H JD 9D 2C TD 6C 9S 4H 6H AH 8S TC 5S 8H JC AS 3H 7D 2S 9C KD TS 7C
Legal plays: 8S 7C 7D
Move?:
The game has come to an end.
Points are as follows
 - Player 1: 0pts
 - Player 2: 0pts
And the WINNERS are:
Player 1 wins!
Player 2 wins!
jm251i@ubuntu2004-014:~/cs246/f21/final$
```

The Enhanced Game in Action

Modded Player Count

```
jm25li@ubuntu2004-014:~/cs246/f21/final$ ./straights --players=0 1
Invalid arguements.
Program is used as follows: ./straights <options> <seed>
Optional parameters:
        <options>:
                --players=[number (POSITIVE INTEGER) of players]
                -a (enables advanced bots to replace ragequitters)
        <seed>:
                [seed (INTEGER) for pseudo-shuffling of deck]
jm25li@ubuntu2004-014:~/cs246/f21/final$ █
```

Firstly, the number of players in the game MUST be >0.

```
jm25li@ubuntu2004-014:~/cs246/f21/final$ ./straights --players=2 1
Is Player 1 a human (h) or a computer (c)?
h
Is Player 2 a human (h) or a computer (c)?
h
Shuffling deck and re-distributing hands.
It's Player 2's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades:
Your hand: KH 4C 6D JH 8D 2D 6S AC 7H QS AD 3D 4S 4D 5H KC 3C QH 7S KS 5C 5D 3S QD QC JS
Legal plays: 7S
Move?:
play 7S
Player 2 plays card 7S.
It's Player 1's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 7
Your hand: 9H 8C TH 2H JD 9D 2C TD 6C 9S 4H 6H AH 8S TC 5S 8H JC AS 3H 7D 2S 9C KD TS 7C
Legal plays: 8S 7C 7D
Move?:
█
```

Secondly, notice, as promised earlier, the 52 cards are distributed evenly amongst the players. Each of the 2 players in this case have 26 cards.

```
jm25li@ubuntu2004-014:~/cs246/f21/final$ ./straights --players=3 1
Is Player 1 a human (h) or a computer (c)?
h
Is Player 2 a human (h) or a computer (c)?
h
Is Player 3 a human (h) or a computer (c)?
h
Shuffling deck and re-distributing hands.
It's Player 3's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades:
Your hand: 7H QS AD 3D 4S 4D 5H KC 3C QH 7S KS 5C 5D 3S QD QC
Legal plays: 7S
Move?:
play 7S
Player 3 plays card 7S.
It's Player 1's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 7
Your hand: 9H 8C TH 2H JD 9D 2C TD 6C 9S 4H 6H AH 8S TC 5S 8H
Legal plays: 8S
Move?:
play 8S
Player 1 plays card 8S.
It's Player 2's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 7 8
Your hand: JC AS 3H 7D 2S 9C KD TS 7C KH 4C 6D JH 8D 2D 6S AC
Legal plays: 6S 7C 7D
Move?:
deck
9H 8C TH 2H JD 9D 2C TD 6C 9S 4H 6H AH
8S TC 5S 8H JC AS 3H 7D 2S 9C KD TS 7C
KH 4C 6D JH 8D 2D 6S AC 7H QS AD 3D 4S
4D 5H KC 3C QH 7S KS 5C 5D 3S QD QC JS
```

Lastly, if the number of players does not evenly divide the deck, there will be missing cards, including 7S. Notice how none of the hands contain JS. Still, each player starts with an equal number of cards to be fair.

Modded Computerization

These bots with "advanced" AI don't play the same as normal bots. They appear when "-a" is in the command-line options, and they will only use the "advanced" AI when replacing a human player (aka when a human player "ragequit").

```
jm251i@ubuntu2004-014:~/cs246/f21/final$ ./straights -a --players=2 1
Is Player 1 a human (h) or a computer (c)?
h
Is Player 2 a human (h) or a computer (c)?
h
Shuffling deck and re-distributing hands.
It's Player 2's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades:
Your hand: KH 4C 6D JH 8D 2D 6S AC 7H QS AD 3D 4S 4D 5H KC 3C QH 7S KS 5C 5D 3S QD QC JS
Legal plays: 7S
Move?:
ragequit
Player 2 plays card 7S.
It's Player 1's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 7
Your hand: 9H 8C TH 2H JD 9D 2C TD 6C 9S 4H 6H AH 8S TC 5S 8H JC AS 3H 7D 2S 9C KD TS 7C
Legal plays: 8S 7C 7D
Move?:
play 8S
Player 1 plays card 8S.
It's Player 2's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 7 8
Your hand: KH 4C 6D JH 8D 2D 6S AC 7H QS AD 3D 4S 4D 5H KC 3C QH KS 5C 5D 3S QD QC JS
Legal plays: 6S 7H
Move?:
Player 2 plays card 7H.
```

Here, player 2 rage quits, and and "advanced" bot takes its place. We can see the new strategy in action during player 2's second move. Unlike the normal bots that would play 6S (as that is what appears first in their hand), this bot plays 7H, the highest ranked card it can play.

```
Player 2 plays card 7H.
It's Player 1's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts: 7
   Spades: 7 8
Your hand: 9H 8C TH 2H JD 9D 2C TD 6C 9S 4H 6H AH TC 5S 8H JC AS 3H 7D 2S 9C KD TS 7C
Legal plays: 7C 7D 9S 6H 8H
Move?:
play 7C
Player 1 plays card 7C.
It's Player 2's turn to play.
Cards on the table:
    Clubs: 7
 Diamonds:
   Hearts: 7
   Spades: 7 8
Your hand: KH 4C 6D JH 8D 2D 6S AC QS AD 3D 4S 4D 5H KC 3C QH KS 5C 5D 3S QD QC JS
Legal plays: 6S
Move?:
Player 2 plays card 6S.
It's Player 1's turn to play.
Cards on the table:
    Clubs: 7
 Diamonds:
   Hearts: 7
   Spades: 6 7 8
Your hand: 9H 8C TH 2H JD 9D 2C TD 6C 9S 4H 6H AH TC 5S 8H JC AS 3H 7D 2S 9C KD TS
Legal plays: 7D 9S 6H 8H 6C 8C 5S
Move?:
play 9S
Player 1 plays card 9S.
It's Player 2's turn to play.
Cards on the table:
    Clubs: 7
 Diamonds:
   Hearts: 7
   Spades: 6 7 8 9
Your hand: KH 4C 6D JH 8D 2D AC QS AD 3D 4S 4D 5H KC 3C QH KS 5C 5D 3S QD QC JS
Legal plays:
Move?:
Player 2 discards a card.
It's Player 1's turn to play.
Cards on the table:
    Clubs: 7
 Diamonds:
   Hearts: 7
   Spades: 6 7 8 9
Your hand: 9H 8C TH 2H JD 9D 2C TD 6C 4H 6H AH TC 5S 8H JC AS 3H 7D 2S 9C KD TS
Legal plays: 7D 6H 8H 6C 8C 5S TS
Move?:
play 7D
Player 1 plays card 7D.
It's Player 2's turn to play.
Cards on the table:
    Clubs: 7
 Diamonds: 7
   Hearts: 7
   Spades: 6 7 8 9
Your hand: KH 4C 6D JH 8D 2D QS AD 3D 4S 4D 5H KC 3C QH KS 5C 5D 3S QD QC JS
Legal plays: 6D 8D
Move?:
Player 2 plays card 8D.
```

Additionally, it discards the lowest ranked card it can. After playing 6S, on its next turn, we see it discard a card. We can't see which card it discards immediately, but if we look at their hand the next turn, AC is missing, the first of their aces which are the lowest ranked cards they possess.

Let's compare this to an unenhanced bot.

```
jm251i@ubuntu2004-014:~/cs246/f21/final$ ./straights --players=2 1
Is Player 1 a human (h) or a computer (c)?
h
Is Player 2 a human (h) or a computer (c)?
h
Shuffling deck and re-distributing hands.
It's Player 2's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades:
Your hand: KH 4C 6D JH 8D 2D 6S AC 7H QS AD 3D 4S 4D 5H KC 3C QH 7S KS 5C 5D 3S QD QC JS
Legal plays: 7S
Move?:
ragequit
Player 2 plays card 7S.
It's Player 1's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 7
Your hand: 9H 8C TH 2H JD 9D 2C TD 6C 9S 4H 6H AH 8S TC 5S 8H JC AS 3H 7D 2S 9C KD TS 7C
Legal plays: 8S 7C 7D
Move?:
play 8S
Player 1 plays card 8S.
It's Player 2's turn to play.
Cards on the table:
    Clubs:
 Diamonds:
   Hearts:
   Spades: 7 8
Your hand: KH 4C 6D JH 8D 2D 6S AC 7H QS AD 3D 4S 4D 5H KC 3C QH KS 5C 5D 3S QD QC JS
Legal plays: 6S 7H
Move?:
Player 2 plays card 6S.
```

Again, player 2 rage quits, but this time they are replaced with a normal bot. On the move our advanced bot played 7H, they played 6S.

Just for fun, let's have a bot showdown. Player 1 and 3 is normal. Player 2 and 4 is advanced.

```
jm251i@ubuntu2004-014:~/cs246/f21/final$ ./straights -a 246
The game has come to an end.
Points are as follows
 - Player 1: 29pts
 - Player 2: 8pts
 - Player 3: 137pts
 - Player 4: 37pts
And the WINNERS are:
Player 2 wins!
```

```
jm251i@ubuntu2004-014:~/cs246/f21/final$ ./straights -a 2021
The game has come to an end.
Points are as follows
 - Player 1: 59pts
 - Player 2: 33pts
 - Player 3: 84pts
 - Player 4: 25pts
And the WINNERS are:
Player 4 wins!
```

```
jm251i@ubuntu2004-014:~/cs246/f21/final$ ./straights -a 20907761
The game has come to an end.
Points are as follows
 - Player 1: 41pts
 - Player 2: 22pts
 - Player 3: 157pts
 - Player 4: 57pts
And the WINNERS are:
Player 2 wins!
```

And the advanced bots win 3 - 0! Pretty convincing victory.

Concluding Statements

This concludes the runthrough of my program, its functionality, and its features. I won't try to hide the fact that this program does lack a test-mode feature and the ability to load pre-saved game states. As a result, there are no other demo files outside of this. There are also some minute details about the code I haven't touched upon and won't matter in the actual compiled program. These include support for custom decks and minute error handling in the case someone were to take my classes and create their own game. These deck's suite and ranks are hard coded into main and used to initialize the game, and some error handling can be seen in main. But, again, this is more for the purpose of creating some resilience to change opposed to becoming additional features, especially as my time is about to run out.

Don't let these distract from the fact that here is a functioning, fully-implemented game with some extra features. The UML for the enhanced program is found in "uml-final.pdf" to better understand how the classes interact, along with the design.pdf describing as best I can the code features and motivation for how things were implemented. And finally, the source code is all here to be analyzed and compiled into the game I presented.