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(1) Design of class structures:

 i. Card: This class is to convert the value of the card to its rank and suit.

 ii. Computer: Computer holds the process of the game.

 iii. Player: Player actually is a Computer player. It does what a real player would do during the game.

 iv. HPlayer: HPlayer means human player. This class could allow a real player to join the Oldmaid game.

 v. Game: This class includes the process of the basic and the bonus game, and if we want to change the rules of basic and bonus games, we can easily change it here.

 vi. OldmaidNormal: The rules of the normal Oldmaid.

 vii. OldmaidVar1:Normal version but a human player can join.

 viii. OldmaidVar2: Similar to Var1, but we randomly removed a card from the deck.

 ix. Version: The class can allow the Player to decide what kind of version they want to play.

 x. Oldmaid(main class): Let the whole game to start.

(2) How a human player should play:

 i. First the player should choose what kind of Version they want to play. 0 for normal , 1 for Var1 , 2 for Var 2, 3 for Var3,4 for Var4, 5 for Var5.

 ii. Then the computer will deal the card, and all the" Player.dropcard()" will drop cards which are the same.

 iii. After all the players finished dropping their cards, then they have to "Player.draw()" draw one card from the other player. As for HPlayer, he/she should input the number to decide which card to draw from the other Player.

 iv. Then repeat all the steps above until the Bonus game over. If the HPlayer is playing Var4 or Var5, they have to guess which is removed or added before the game started.

(3) Test the correctness of your program

i.   Add Tests: The Test program will produce random int or string as input. Then the program will run all the tests and stop when bugs occur. The input will cover the requirements and exceptions.

ii.   Write some code: Write some new codes to fix the bugs. And repeat Step i.

iii.   Human Test: Then the human will test the code several times by running the formal program, and test whether the result is against the rules of the Game, if so, do step ii.

(4) The sample output for two program

```
Var1: What kind of version do you want to play? 0:Normal version, 1:Normal
human version, 2:one card removed human version
1
Hi! You are Player0 now!
Deal cards
Player0:  D3  S6  S7  D7  S9  H9  SJ  CJ  SQ  CQ  SK  CK  SA  DA
Player1:  S4  C4  D4  H4  S5  C5  C6  D6 C10 D10 H10  DQ  HQ  HK
Player2:  B0  S3  C3  D5  H5  C7  H7  C8  H8  DJ  HJ  CA  HA
Player3:  R0  S2  C2  D2  H2  H3  H6  S8  D8  C9  D9 S10  DK
Drop cards
Player0:  D3  S6
Player1: H10  HK
Player2:  B0
Player3:  R0  H3  H6 S10  DK
Game Start
Which card do you want to draw from Player1? Please enter: 1-2
1
You draw a card from Player1 H10
Player0:  D3  S6 H10
Player1:  HK
Player1 draws a card from Player2 B0
Player1:  B0  HK
Player2:
Player2 wins
Basic game over
Player3 draws a card from Player0 S6
Player3:  R0  H3 S10  DK
Player0:  D3 H10
Which card do you want to draw from Player1? Please enter: 1-2
1
You draw a card from Player1 B0
Player0:  B0  D3 H10
Player1:  HK
Player1 draws a card from Player3 R0
```

```
Player1:  R0  HK
Player3:  H3 S10  DK
Player3 draws a card from Player0 D3
Player3: S10  DK
Player0:  B0 H10
Which card do you want to draw from Player1? Please enter: 1-2
1
You draw a card from Player1 R0
Player0:  R0  B0 H10
Player1:  HK
Player1 draws a card from Player3 DK
Player1:
Player3: S10
Player1 wins
Player3 draws a card from Player0 H10
Player3:
Player0:  R0  B0
Player3 wins
Bonus  game  over
```
Var2: What kind of version do you want to play? 0:Normal version, 1:Normal human version, 2:one card removed human version

2

Hi! You are Player0 now!

Deal cards

Player0: H3   H4   C6   D6   S7   H8   H9 C10   SJ   HJ   DQ   SA   CA
Player1: S2   C3   D3   S4   D4   S5   C5   H5   S9   D9   HQ   SK   HK
Player2: D2   D5   S6   D7   S8   D8   CJ   SQ   CQ   CK   DK   DA   HA
Player3: C2   H2   S3   C4   H6   C7   H7   C8   C9 S10 D10   DJ

Drop cards

Player0: H3   H4   S7   H8   H9 C10   DQ
Player1: S2   H5   HQ
Player2: D2   D5   S6   D7   CJ
Player3: S3   C4   H6   C8   C9   DJ

Game Start

Which card do you want to draw from Player1? Please enter: 1-3

3

You draw a card from Player1 HQ

Player0: H3   H4   S7   H8   H9 C10
Player1: S2   H5
Player1 draws a card from Player2 D5
Player1: S2
Player2: D2   S6   D7   CJ
Player2 draws a card from Player3 C9
Player2: D2   S6   D7   C9   CJ
Player3: S3   C4   H6   C8   DJ
Player3 draws a card from Player0 H4

Player3:   S3   H6   C8   DJ
Player0:   H3   S7   H8   H9 C10
Which card do you want to draw from Player1? Please enter: 1-1
1
You draw a card from Player1 S2
Player0:   S2   H3   S7   H8   H9 C10
Player1:
Player1 wins
Basic game over
Player2 draws a card from Player3 C8
Player2:   D2   S6   D7   C8   C9   CJ
Player3:   S3   H6   DJ
Player3 draws a card from Player0 S2
Player3:   S2   S3   H6   DJ
Player0:   H3   S7   H8   H9 C10
Which card do you want to draw from Player2? Please enter: 1-6
3
You draw a card from Player2 D7
Player0:   H3   H8   H9 C10
Player2:   D2   S6   C8   C9   CJ
Player2 draws a card from Player3 DJ
Player2:   D2   S6   C8   C9
Player3:   S2   S3   H6
Player3 draws a card from Player0 H8
Player3:   S2   S3   H6   H8
Player0:   H3   H9 C10
Which card do you want to draw from Player2? Please enter: 1-4
4
You draw a card from Player2 C9
Player0:   H3 C10
Player2:   D2   S6   C8
Player2 draws a card from Player3 S2
Player2:   S6   C8
Player3:   S3   H6   H8
Player3 draws a card from Player0 C10
Player3:   S3   H6   H8 C10
Player0:   H3
Which card do you want to draw from Player2? Please enter: 1-2
1
You draw a card from Player2 S6
Player0:   H3   S6
Player2:   C8
Player2 draws a card from Player3 H8
Player2:
Player3:   S3   H6 C10
Player2 wins

Player3 draws a card from Player0 H3

Player3:   H6 C10

Player0:   S6

Which card do you want to draw from Player3? Please enter: 1-2

1

You draw a card from Player3 H6

Player0:

Player3: C10

Player0 wins

Bonus game over

Guess which card is removed before the game started. Input Ex:S3

H10

Congratulation! You got it!

(5) Bonus points:
  i.   Human can join the game.
  ii.   Var2 allow the human player to guess which card is removed , make the games more interesting.
  iii. Programs can catch exception so even the human player misinput , the program won't break down and will ask the player to input again.