Report

Strategy

My Gin Rummy AI implements a heuristic approach where it saves additional information about the game in **memory** and utilises the memory to enhance decision at each turn.

Memory

The memory is in the format of "1 (0,25) S4H6H8 C6DJ DKS8" as an example.

For a clearer picture, the BNF grammar for the memory is shown as below, but with space, digits and Card not defined. <fullMem> is a string separated by space.

<fullMem> ::= <turn> <scores> <discards> <opponentPicked> <deadwood>
<turn> ::= <digits>
<scores> ::= (digits,digits)
<discards> ::= <[Card]>
<opponentPicked> ::= <[Card]>
<deadwood> ::= <[Card]>

Turn

In the memory string, the first single digit refers to the game turn. It is updated in every turn by incrementing one. Each round is updated by checking whether the current scores of opponent and player (passed as function arguments) is the same as their previous scores (saved in the memory). It is done by reassigning the game turn in memory back to 1 to indicate a new round.

Scores

(0,25) is a tuple of integers where the first value is the player's previous score and the second is the opponent's previous score. When there is a change of scores, after using these values to verify the changes to update the game turn, it will be updated to the current one when pickCard function is called.

String of Cards

It is a string of different cards concatenated together. The memory format of the Card is a string of two characters where we take the first letter of the Suit and the numerical Rank of the Card. For example, S2 for Card Spade Two. After parsing, the string of cards separated by space will be parsed into three lists of cards, which are the discarded card list, opponent's picked card list and deadwood list respectively.

Discarded card list

After being parsed, the discarded card list consists of cards which are in the discard piles observed by the player. Cards that will be added to this list are the cards that the player chooses to discard in the playCard function and also the card on top of the discard pile if the opponent's last draw is from Stock. If an opponent draws from Discard, then it will be handled in the function which parses and stores information in the opponent's picked card list.

Opponent's picked card list

After being parsed, this list will consist of cards that the opponent picks from the discard pile which the player observes. If an opponent's last draw is from the Discard pile, the head of the discard list will be added to this list, as the head will always be the last discarded card from the player. (The card to be discarded by the player is stored as part of the memory string every time playCard function is called).

Deadwood list

To save computational time and improve efficiency of my code, I store deadwood in the memory from hand in playCard and update it every time this function is called. This is done so that when makeMelds function is called, there is no need to filter deadwood out of the current hand to make melds anymore. We will just need to parse the memory and get the Deadwood list from the memory. The Deadwood is of type Card, thus it is still needed to be converted to type Meld for the return result of the makeMelds function.

How game AI make decision to discard which card

1. The player can make decisions based on the deadwood the player currently has and the discarded card list from the memory. If there is any card in the deadwood which can possibly form melds with the card in the discard piles, player should prioritise discarding these cards. If there is more than one card which matches with the discard piles, then choose the card with the highest rank.
    a. This is because it has lower probability for the player to form melds with the remaining deadwood if the needed card is already in the discard pile.
2. The player can make decisions based on the deadwood owned and the opponent's picked list in memory. The player should not discard the card with the same rank or with the difference of one in rank with the opponent's last picked card.
    a. For example, if the opponent picks Card Spade Three, it is possible that it wants to form Straight which needs Card Spade Two or Card Spade Five or Set which needs any other card with rank Three.

From the explanation above, it is clearly shown that the memory stored is very helpful to make decisions for my game AI. Instead of only checking with the player's possible melds for

the remaining deadwood, this approach helps prevent the player from discarding cards that will help the opponent to form melds.

How game AI make decision to pick from Discard or Stock

1. Firstly, AI will sort possible sets formed with the current hand along with the top card of the discard pile. If there is at least one possible match, then the player will draw from Discard.
2. Next, AI will sort possible straights formed with the current hand along with the top card of the discard pile. If there is more possible Straight formed from the hand along with the card compared to possible Straight formed with only the hand, then the player will also draw from the Discard stack.
3. Otherwise, the player will draw the card from the Stock. There is no other condition for the player to draw from Discard because the card on top of the Discard stack is visible to all players and therefore this becomes a risk especially if the opponent is good at card counting.

Additional decision / strategy

1. Set is always formed and sorted out before Straight. This is because once a player has a set, especially Set 4, then there is a possibility that it will be difficult for the opponent to form Straight if the Set 4 the player has is the middle rank between the opponent's potential Straight.
2. When the opponent's score is approaching 100, the player will prioritise on discarding the card with the highest value so that when the opponent announces Knock, the value of deadwood could be lower. This is to ensure the opponent does not win too many points for the current turn and win the whole game.

Reference

- Week 11 Tutorial on Parser Combinators
- https://www.denexa.com/blog/gin-rummy-strategy/
- https://www.gamecolony.com/gin_rummy_game_strategy.shtml
- https://www.thesprucecrafts.com/gin-rummy-card-game-strategy-and-tips-412364