Bever Gang - Strategy Rules
(Multi-Agent Systems Project)

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In our model, the game handles the game rules. When the agent at turn has a choice, the game asks the agent what he wants to do. So, when an agent is at turn, he faces multiple decisions from which multiple possible actions can arise. Which decision the agent makes, is handled by the agents strategy base and is dependent on the worlds this agent still knows are possible. First, the agent will decide whether to draw a card from the closed or from the open pile. Then, the agent chooses to play his drawn card or discard it. If the agent chooses to play his card, he specifies to the game how he would like to perform the specific play action. When there are no more possible actions for the agent, the game gives the turn to the next agent.

Regular Strategy

1   Get a card from the open or closed pile?

If the card on the open deck is higher than or equal to the average card value in the game, the agent decides he can do better by drawing a card from the closed deck. In case of a higher than average card, the agent has a bigger chance of getting a more beneficial card from the closed deck, since this card will on average be lower. In case the open card is equal to average, the agent might not have a greater chance of getting a better card from the closed deck, but then at least the other agents will not know the value of his drawn card.

If the card on the open deck is smaller than the average card value in the game, the agent will estimate the average card value of all his own cards. If he knows one of his own cards, the average card value is of course equal to the true value of the card. He then focuses on his card with the highest average card value (see Section 3). If this card is higher than the card currently on the open deck, he chooses to pick the card from the open deck. If his own card is lower, then he decides there is no point in picking up the open card and he goes for the closed deck instead, hoping for an even lower card.

Note: When there is a special card on the open deck, the game will not ask the agent what the agent would like to do, since getting the special card is forbidden in the game rules.

2   Play or discard?

2.1   Peek

If the card in the agent's hand is a Peek card, the agent will check if he knows all his cards. If he knows all his cards, he discards the 'peek'-card. If there is at least one card he doesn't knows yet, he will peek at that card.

2.2   Swap

If the card in the hand is a 'Swap'-card, the agent will reason which of his own cards is the highest card (see Section 3) and which of the other agents cards is the lowest card (see Section 4). If the lowest card

from the other agent has a lower expected value than his own highest card, he will swap these two cards. If the expected value is higher, he won't swap and he will discard the 'swap'-card. If the values of the cards are the same, he will reason about how much he knows himself about both cards. He will swap if he is more certain about the other card's value (he wants to know as much as possible about his own cards), otherwise he will discard the 'swap'-card. If his knowledge about both cards is the same as well, he will reason about how much he thinks other agents know about both cards. He will swap if he thinks other agents know more about his card (he wants other agents to know as little as possible about his own cards), otherwise he will discard the 'swap'-card.

2.3   GetTwo - Get a second card?

After playing a 'Get Two'-card, the agent can draw two more cards from the closed deck. He can choose to keep his first drawn card, or to discard this one and draw a second card. The choice between keeping the first card or drawing a second card strongly resembles the strategy in which the agent chooses between drawing a card from the open or from the closed deck.

After drawing the first card, the agent checks whether the value of this card is higher than or equal to the average card value in the game. If this is the case, the agent estimates he can do better by drawing a second card. If this is not the case, the agent checks the value of his first card against his own highest card. If his first drawn card is higher than his highest card, he knows he can do equal or better by drawing a new, second card and does so. However, if his first card is lower than his highest card, he is satisfied and keeps the first card he drew with no need of drawing a second one.

2.4   Put a card?

If the card in his hand isn't a special card, the card must have a value. If this value is lower than his own highest card (see Section 3), he will put the card in his hand on the position of his own highest card. If the value is higher than his own highest card, he will discard the card. If the value of the card in his hand is the same as the value of his own highest card, he must reason some more. If the value in his hand is the highest card in the deck, he will discard the card, because other agents won't get new knowledge when he discards the highest card in the deck. If this isn't the case, the agent will check how much he knows about his highest card. If he is uncertain about his highest card, he will put the card in his hand on that position (gaining more certainty about his own cards). If he knows the exact value of his highest card, he will reason about how much other agents know about his highest card. When he thinks other agents might know more about his card, he will put the card in his hand on the position of his own highest card (letting other people know as little as possible about his own card). Otherwise he will discard the card in his hand.

3   Get highest card

To determine which of his own cards is the best card to discard (or swap), an agent uses different knowledge. The agent goes through his cards one by one and he keeps track of the best card to discard. For each card the agent checks if the value of that card is lower than the current worst card. If so, the agent will keep this card. If the value is higher, the card he's currently checking will become the current best card to discard. If the value, on the other hand, is equal to the value of the current best card to discard, the agent will check for other information.

The first thing the agent does is checking how certain he is about the value of both cards. For example, the agent can think his card has an average value of 3, but this can also mean that he knows that the card must have a value lower than or equal to 6. In this case, the agent is much less certain about the card. An agent wants to get rid of uncertainty, therefore, the card with the highest uncertainty will be chosen as best card to discard. If it is the case that the agent is equally certain about both cards, the agent will look at second depth knowledge. Of course, you want to discard the card where other agents know the most about. The less agents know about your cards, the better. Therefore, the agent checks what he knows about what other agents know about his cards. The more agents know, the better it is to discard that card. If the agent knows that the other agents know equally about both cards, it does not matter which card to discard.

4   Get lowest card

When swapping you want to pick the best card from another agent. The best scenario is where you pick the lowest card available from the other agent's cards. Similarly as with determining the best card to discard, here the agent keeps track of the best card to pick. First off, the agent consults his first depth knowledge about what he knows about the cards of the other agents. He checks the cards one by one. When he finds a card with a higher value than the current best card to pick, he won't bother picking that one. When he finds a card which has a lower value than the current best card to pick, the card he's currently checking will become the current best card to pick. When the values of both cards are the same, the agent will need to consult other information. As with picking the best card to discard, the agent here will want to pick the card that he is more certain of. If it is the case that the agent is equally certain about both cards, the agent will look at second depth knowledge. An agent favors a card where other agents know the least about. Therefore, the agent checks what he knows about what other agents know about these cards. The less agents know, the better it is to pick that card. If the agent knows that the other agents know equally about both cards, it does not matter which card to pick.

The paranoid and psychic agents

The paranoid and psychic agents use a slightly different strategy, which are fully described at the website.

Final remarks

With this list of strategy rules we probably haven't reached completeness. However, it is the most rational strategy we could come up with ourselves. In addition, using this strategy, our agents reason and apply knowledge with very good results.