Flex; cardgame-@rena : Alpha version Announcement of a New Platform for AI agents of Trading Card Games.

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Abstract— **In studies of AI agents of games, one of our interests is to propose a universal platform of the game in order to share various methods of strategies of agents and to compare their accuracy and other 'goodness.' In this paper we discuss the minimum requirements to be a standard platform of Trading Card Game (TCG), comparing existing platforms of TCG in these days.** *Flex; cardgame-@rena* **is a proto-type system of such platform implemented by the first author.**

I. INTRODUCTION

In recent years, the theory of AI agents of games with perfect information has been much progressing and AI agents of games such as chess and shogi and go become superior to human players. On the other hands, we are interested in studies of not only good AI players but also human-like AI players or good AI teachers for human players. In this paper we deal with a typical Trading Card Games (TCG) such as Magic; The Gathering and we propose an alpha-version platform for AI of TCG. The first author is implementing a proto-type *Flex; cardgame-@rena* [1] of the platform.

TCG has some interesting features not only in a viewpoint of the game theory but also in a viewpoint of implementation of AI agents of the game. There are two phases in TCG, one is building a deck from a pool of cards and the other is battling with the cards of his own deck. Deckbuilding is one of the important parts of TCG and we hope to argue effective agents or human-like agents of building a deck for a given pool of cards. Moreover in the battling phase, each TCG player has to estimate cards in others' deck through playing games. We need to discuss *metagameness* of TCG, that is, analyzing the trend of strategy of the opponent and constructing counterplans of such trend.

In order to know well such a unique game, we want a standard and universal platform for AI agents of TCG. For example, *Metastone* [2] is a simulator of *Hearth Stone* and some researchers have already tried to implement agents of this game. But this is only a simulator of a specific game, and the authors consider that after making the minimum requirement of a platform of TCG clear, we suggest a standard platform to develop AI agents of TCG.

II. RELATED WORKS

Cowling et al. [3] focus optimized agents in Magic; the Gathering. First they fix a pool of cards and/or fix a deck to play. Thus they apply some methods (MCTS, or Determinization) to this game and optimize agents' play and verify effectiveness of these methods.

In [4], García-Sánchez et al. try to strengthen a deck in MetaStone platform by using the genetic algorithm. They fix an AI agent and comparing many kinds of deck and select the best deck for the agent. Finally they succeed in developing a strong deck under the assumption of fixing an agent.

In [5], Betley et al. prepare classified (in advanced) two types of decks in TCG and they fix an agent. Under this condition they try to estimate the winning percentage of games.

In [6], Yamada et al. prepare many kinds of decks determined randomly. They optimize one agent by neural network and estimate the efficiency of the learning.

III. IMPORTANT FEATURES IN TCG

In this section we discuss the minimum requirement of the rule of TCG in order to determine the specification of a platform for AI agents. As we know well, TCG has two phases. At the first phase, players build their decks. The deckbuilding is a kind of activities where each player directs his character in the next phase. At the second phase, players use their decks and compete with each other. Thus TCG has a complicated structure in its rule, and we often set some conditions to discuss easily. Here we confirm the requirements in order to release limitations of the rule as most as possible.

A. Deckbuilding

1) Meta game

Generally, we believe that the strongest selection of a deck does not exist in TCG. Each deck always has several weak points, and if one meets an incompatible tactic, he/she has a difficult time with the opponent. Moreover in a big contest or a convention of the game, there might be a trend of strategy. Participants should analyze the trend and take measures before they build the deck. Or they may think that they need some more measures to beat another 'measured deck.' Such horse-trading is called *metagame*, and it is one of the really important factors in TCG. The authors consider that our platform of TCG may contain this factor in its architecture.

2) Choice of cards

If a built deck consists of so-called strong cards, the deck is not always a good deck. Usually any deck must be built under a certain policy. For example, agro, one of the famous types of decks, adopts cards with the idea, 'avoiding a long game battle and reducing the opponent's life as soon as possible.' Suppose that one player wants to build his deck in

an agro way. There are a lot of characteristics of cards in the pool of cards and he has to choose cards such as his policy will be realized. Even if there is a card whose characteristic is "having strong status only when the opponent's life point is high" in the pool of cards, he may not adopt this cards because of his policy. As shown in this example, choice of cards is not determined in the automated way but in the political way. In the viewpoint of AI agents, we hope to manage to treat unfixed policies of the player in a certain sense.

3) Allocation of specific cards

Several TCGs have an idea, 'the pool contains a specific card which only feed costs to other cards.' Such card is often called *land* or *energy*. Though such cards are indispensable in any decks, they turn worthless once they are opened and are used. Each player needs to adjust the total number of land cards in his deck, adapting the total costs of the cards in the deck. If the deck includes many large-cost cards, it must contain many land cards too. This factor makes the game deep. In our platform, we hope to leave place for learning various roles of such cards by machine learnings.

B. Competing

1) Large invisible area with tendencies

There are many objects in TCG, for example, a deck, player's hands, cards in the battlefield, and so on. Each player can see the cards in the battlefield and his own cards in the hand. (One is not allowed to see cards in the graveyard but it is enough to remember them.) Thus there are many invisible cards in the battle phase. In the other card games, invisible cards means perfectly random pool, but in TCG player must worry the invisible cards, because they has some tendencies depending on his own policy and the opponent's policy. His own deck is a product by himself, but the top of the deck is a random card with his policy's tendency. As mentioned above, a player speculates the opponent's tactic from the opponent's battlefield, where the top card of the opponent's deck is a random card with supposing opponent's policy. Thus if we consider a game tree in the usual way of thinking, the size of the tree might be too large.

2) Actions suit for deck's strategy

In the battle phase, each player must act rationally in the battlefield. He has to take over his own tactic which he has in the deckbuilding phase. In this viewpoint, an agent who can play cards constantly a little well for any deck is much inferior to an agent who plays so well depending on his strategy.

3) Knowledge about pool of cards and environment

It need scarcely be said that each player must know well about the characters of pool of cards. Usually the difference of the pool of cards is apparent as a difference of the rules of the various games. In our platform, we are allowed to define a characteristic of the pool of cards and to construct many categories of competitions using one platform.

IV. EXISTING PLATFORM

MetaStone is an existing TCG platform. It is published as a simulator of *Hearth Stone*, a collectible card game on web.

The reference [7] is based on this platform. In MetaStone, a player has to choose a Hero from several unique characters, and he must build his deck from restricted cards, that is, the specific cards of the Heroes and the neutral cards which are shared to all players. The specific cards have specific ability depending on the Hero's skill.

This part of the rule of MetaStone is a drastic restriction of the rule of TCG. Indeed, each player are allowed to know the opponent's Hero. For that reason any player can speculate opponent's tactic roughly. Of course this is a kind of the simplifications of complicated TCG's rules. We plans that our platform has universality of rules and that there is a space for agents to speculate opponent's tactic from opponent's actions.

In addition, in MetaStone, one parameter named *mana* (that means the cost to use cards) increases automatically by each turn. This is a kind of contrivances to prevent the game from being boring because of lacking of mana. About this rule, not only in the viewpoints of universality but also from existence of the land cards, we have an option of omitting this rule in our platform.

V. PROPOSED PLATFORM

In this paper, we suggest a new platform of TCG which expand existing environments. In our platform, we are allowed to make a rule of innocence about the opponent at the beginning of the sequence of games. We are implementing this platform by python, it is because creators of agents can use machine learnings easily. The rule is stated as below.

1) The number of players is two. The players build their decks by choosing at least D cards from P*Q cards, where the pool of cards contains P kinds of cards and it contains Q cards in the pool per type.

2) The first player is determined by random. Each player has two status papameters, <u>life</u> *(the initial value is L) and* <u>mana</u> *(the initial value is 0.) Each card has several status parameters,* <u>cost</u> *(C),* <u>power</u> *(P), and* <u>toughness</u> *(T). Some kinds of cards have special effects as skills of the cards.*

3) First player draws N cards, second player draws N+1 cards from the deck of their own respectively. These cards will be their initial hand. Let the first player be the active player at the beginning.

4) The active player untaps all card in his battlefield, and draws a card from his deck. (If this game is 'no land rule', the active player increase his mana by 1 up to M). If his deck is exhausted, the player loses....(1)

5) After (1), the active player are allowed to play actions below a), b), and c) at any time, in any order while he can pay his cost. By these actions, if the toughness of a card turns 0 then the card must go to the graveyard. ...(2)

　a) The active player plays a card with consuming its cost. If the card is a creature, the card comes into the tapped position. If the card is a land, it is played once a turn.

　b) The active player activates a card's skill on the battlefield. Activation demands a cost determined for each card.

　c) The active player taps a creature card of his own to attack an opponent's creature or the opponent. The attacking creature can reduce one of the toughness of the attacked card and the life of the opponent by the number of the power of the

attacking creature. If the toughness of the attacked creature turns 0, it must go to the graveyard.

6) If the active player calls turn-end, the other player becomes an active player….(3)

7) Players iterates above steps (1)-(3) until the life of either player is 0 or negative.

We can edit the option of the rule in a configuration file named "rule.json". In the latest version, the land rule does not have been implemented and we will soon implement it as an option. The source code by python is opened at a github site [1], thus researchers can create an original agent using rich deep-learning libraries of python.

VI. Conclusion and Future works

In this paper, we discuss the requirement in a platform of TCG, we pointed out some features in MetaStone, and we explain the rules of our platform with reference to the existing systems.

In the future, we plan to extend the rule of our platform, for example, adding land cards and sorcery cards in the pool of cards. And conducting various experiments on AI agents of TCG with our platform, we will clarify its usefulness and the validity of our platform. In the near future, we will hold a public contest of AI agents of TCG on our platform.

References

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