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THE LOGIC OF PIT

ABSTRACT. Pit is a multi-player card game that simulates the commodities trading market, and where actions consist of bidding and of swapping cards. We present a formal description of the knowledge and change of knowledge in that game. The description is in a standard language for dynamic epistemics expanded with assignment. Assignment is necessary to describe that cards change hands. The formal description is a prerequisite to model Pit in game theory. The main contribution of this paper should be seen as the rigorous formalization of all knowledge in Pit.

1. INTRODUCTION

The object of Pit is to corner the market on Barley, Corn, Flax, Hay, Oats, Rye and Wheat by trading cards with other players. Pit can be played by three to seven players. There are nine cards in each suit. If three play, use only three complete suits. If four play, use four complete suits, etc. Use the complete Pit deck for seven players. Place the trading bell in the centre of the table and select one player to shuffle the deck and deal nine cards to each player. The Dealer should allow the players 30 s to sort their cards and decide mentally on which commodity (Wheat, Rye, Oats, etc.) they will attempt to corner. Players should try to corner the commodity of which they hold the most cards. When the cards have been sorted, the Dealer strikes the bell and announces, “The Exchange is open.” Then, any player may begin to trade cards with other players. To trade, he takes from his hand one to four cards of the same suit, holds the cards up so that the suits do not show and calls out, “Trade One! One! One!” or “Two! Two! Two!” or “Three! Three! Three!” or “Four! Four! Four!” depending on the number of cards being traded. Players continue calling out their numbers until the cards have been exchanged. If a player wishes to exchange cards with another player, he must call in return, “One! One! One!”, “Two! Two! Two!”, etc., and trade an equal number of cards of the same suit with that player. If a player wishes to trade three or four cards and other players will only exchange lower numbers, he may drop his bid and trade the smaller number of cards. Trading continues until one player gets nine cards of the same suit. That player must quickly ring the bell and call out, “Corner on Wheat!” (or whatever the commodity may be). The player then scores the amount marked on the commodity he has cornered (Wheat, 100 points; Oats, 60 points, etc.) and records this on the score pad. When a corner is won, all the cards are reshuffled and dealt by the last winner and another corner is played for. The game is won by the first trader to get 500 points.
Pit is a multi-player card game where actions consist of swapping cards. The first player to declare a certain hand of cards wins a round of the game. From a differing theoretical point of view, various ramifications involving the Pit game have been investigated (Holt 1996; Purvis et al. 2004). The former uses the general idea of ‘trading in a Pit’ to illustrate the supply and demand cycle in the general economics classroom. The latter may be seen as a study in requirements engineering for electronic market simulations. In this paper we address the logical dynamics of the game. Its game theory has been investigated in van Ditmarsch (2004). The starting point to specify the logical dynamics is the language presented in van Ditmarsch (2002). This forms part of an ongoing line of research in dynamic epistemics, see also Gerbrandy, (1999), Baltag and Moss (2004) for further references. In van Ditmarsch (2002) the logical dynamics was specifically used to describe (other than Pit) card game actions. Another starting point are the card game state descriptions presented in van Ditmarsch et al. (2003).

The structure of this paper is as follows. In Section 2 we present an abstraction from the real game that facilitates formalization, and we give an informal overview of game states and game actions. We also introduce the SixPit game: a running example of a Pit game for three players and three commodities of each two cards. Section 3 contains logical preliminaries. It summarizes the dynamic epistemics of van Ditmarsch (2002), and introduces the new atomic action construct ‘assignment’, that is essential to describe the trading of cards. Section 4 contains the formal description of the Pit game, illustrated by examples from SixPit. Section 5 outlines the relevance of this investigation for the game theory of Pit and other knowledge games.