

Optimal strategy in games with chance nodes

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Abstract

In this paper, games with chance nodes are analysed. The evaluation of these game trees uses the expectiminimax algorithm. We present pruning techniques involving random effects. The gamma-pruning aims at increasing the efficiency of expectiminimax (analogously to alpha-beta pruning and the classical minimax). Some interesting properties of these games are shown: for instance, a game without draw can be fair. A fair game may not be fair any more if it is played iteratively. To handle these phenomena, the use of additional indicators, such as the minimal guaranteed outcome value, is suggested.

Keywords: Game Theory, Artificial Intelligence, Game tree, Games with chance nodes, Expectiminimax algorithm, Pruning, Iterative games, Fair games

1 Introduction

Game Theory is an important field of Artificial Intelligence. Modern game theory was defined by von Neumann and Morgenstern [6, 7]. Game theory deals with decision problems in an environment where another agent or agents may have different aims. The theory of two player strategic games is well developed [5, 9, 10]. A sub-field, the theory of fixed sum games, is equivalent to the family of zero-sum games, where two players have opposite aims. In games with perfect information players have all the information about the game to help to make their decisions (also called steps or moves). These games are represented by game trees. In these graphs there are two kinds of nodes representing the decision points of the two players. Game theory deals with well-defined games where players can choose among a fixed set of actions. NIM, Tic-Tac-Toe, Othello [1] and Chess are representative elements of this set. The first computer chess program was developed by Shannon and Turing in 1950. One of the main aims of the artificial intelligence research was to write a chess program that can beat the human world chess champion. It was a long process, but nowadays computer programs do beat human champions.

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