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New algorithms and their software implementations for some combinatorial games

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Combinatorial game theory is a mathematical theory that studies two-person games in which there is a position at any given time that players alternately alter (according to the rules) to achieve a win. This theory does not study games related to chance, only games in which positions and all known moves are known to both players [1], [2].

The application of combinatorics game theory to a particular position in a game (conflict) consists of the determination of the optimal sequence of motions for players to the end of game, that is by the determination of optimal motion in every position [3].

For many combinatorial games of perfect information (for example, Go, Nim and TakTix) it is known that there are algorithms that determine whether or not the player moving first has a "forced win" from a given starting position. So we can conclude that such an algorithm decides the game. To such algorithms, it is possible to take a decision tree (schematic presentation of the problem of making a decision), greedy algorithm (basic problem to take away as possible any more chips from the field), symmetric algorithm (an imitation of the motion of rival that is on other part of the playing field) and others. One of the combinatorial games is TakTix, developed by Pete

Hein. Chips (or coins, pebbles) are laid out on a board of size $n \times m$ or $n \times n$. At the beginning of the game, players determine the maximum and the minimum number of chips that can be taken in one move. Each player is allowed to take any horizontal or vertical sequence of consecutive chips. TacTix is played with the misre version, meaning that the player that takes the last chips loses, or wins in the non-misre version.

There exist winning strategies for players (for non-misere games):

- For the First Player : If N is odd, then take the centerpiece and copy every move your opponent makes symmetrically. Eventually, you will take the last piece and will win.

- For the Second Player - If N is even, then copy your opponent's moves symmetrically. Eventually, you will take the last piece and will win. The proposed algorithm for the TacTix game is more optimal than existing algorithms. The application of the algorithm does not affect the computer implementation of the game, but the number of moves to win is more optimal. The computer implementation includes the ability to play not only with the computer but also with another player.

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