

COMS W4995 003
Parallel Functional Programming
Fall 2024

Project Proposal

Title: Generalized Tic Tac Toe Solver

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Objective

Determining the optimal move in generalized Tic Tac Toe is an NP-complete problem, especially as the board size and the number of players increase. This project aims to develop a parallelized solver for generalized Tic Tac Toe using Haskell's functional programming paradigms to enhance performance and scalability.

Game Rules:

- **Board Configuration:** The game is played on an $N \times N$ grid, where $N \geq 3$.
- **Players:** Two or more players take turns placing their respective symbols on empty cells.
- **Win Condition:** A player wins by placing K consecutive symbols in a horizontal, vertical, or diagonal line, where $K \leq N$.
- **Draw Condition:** If all cells are filled without any player achieving the win condition, the game ends in a draw.

Approach & Methodology:

We will implement the Minimax algorithm without Alpha-Beta pruning as a sequential solver. We limit the board size up to 5×5 . The idea is to parallelize the evaluation of possible initial moves in the Minimax algorithm. Each possible move from the current state will be evaluated in parallel to determine the best move. Then, we utilize the parallel library, leveraging constructs like `par` and `pseq` to manage concurrent evaluations effectively.

Performance Benchmarking

To measure the performance, we measure execution times of both solvers for each board size. We will use simple timing functions to record performance metrics.

6. Expected Results:

Following are the questions that are expected to be answered by the results.

- Does the parallel algorithm show a significant performance improvement?
- How well do the algorithms perform as the grid size increases?

