Exploring Reversi Endgames via Parallelization

Devanshu Pandey
University at Buffalo
CSE633-Parallel Computing
December 2, 2010

Reversi and the endgame

- Demo
- Branching factor – 4 –(Please note that this is something I erroneously picked for my project based on scarce empirical observation). You can find an average of 6-7 moves at each point.
  - Important to my implementation
- Initial central idea – Vary the size of the endgame
- Later implemented Monte Carlo Tree Search
- Parallelizing alpha-beta pruning too difficult
  - Parallel Variant Splitting

Implementation

- Python
- MPI work
  - mpi4py
  - MPICH II
- Why?
  - Python's ease of use
  - Testing MPICH II

The Board

- An 8 x 8 array
- State based implementation
  - Initializing states
  - e_count
- The possible moves function
  - Inefficient?

The parallel algorithm

- Master-Slave implementation
- Root starts the game, initializes the board state
- Calls the possible moves function.
- An average of 4 possible moves, one move per processor

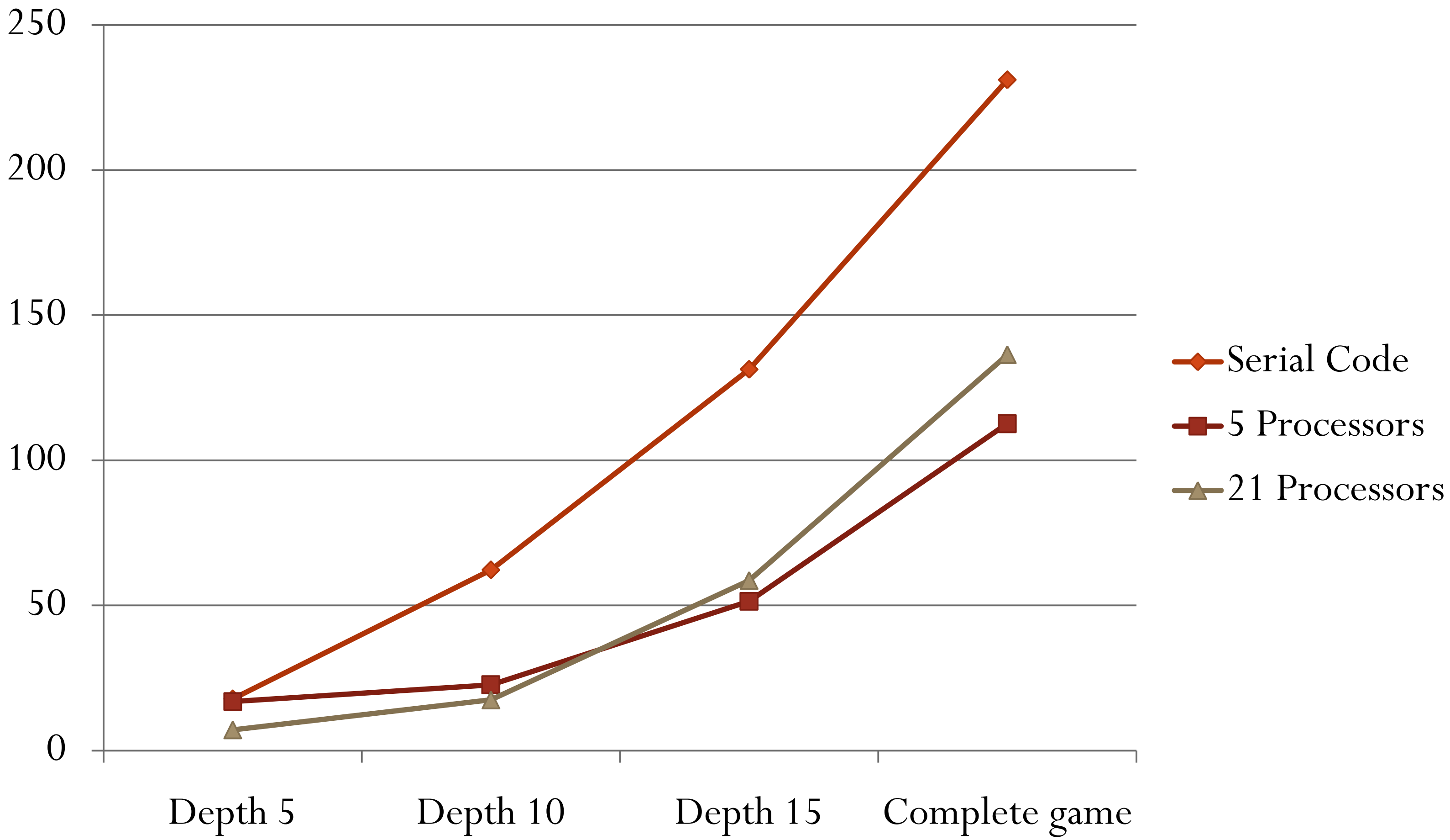
Tasks for every slave PE

- Monte Carlo Tree Search
  - Play random moves till game ends.
- Store the win ratio (# wins/ # times move was played) in a transposition table
  - Transposition table:
    - An array of length 64
    - For position (r, c), index = 8r + c
- In the end, return the transposition tables to the master
- "Zip" the tables together to get final values

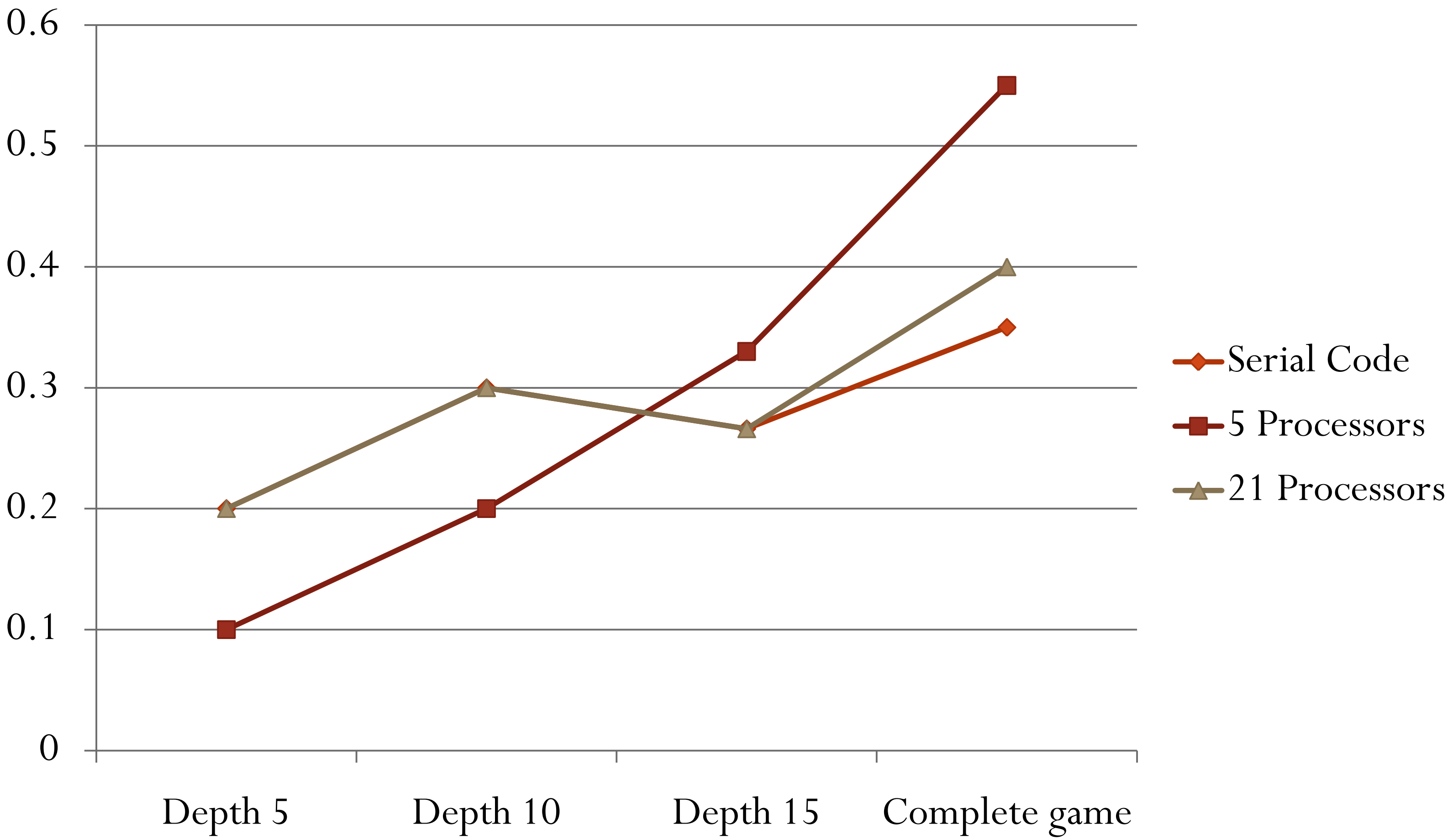
Problems

- Full blown tree shaped architecture
  - My implementation – truncated
    - CCR problems
    - Bad implementation
- Code translation
  - Time hog
  - Led to inefficient time and space usage

Time (ms) v/s Endgame size



Win Ratio v/s Size of Endgame



Future work

- C implementation
- Achieve time and space efficiency
- MCTS on CUDA

References

- Analysis of Alpha-Beta Pruning. *D. E. Knuth and R.W. Moore*. Artificial Intelligence 6:293-326, 1975
- Artificial Intelligence – Second Edition. *P. H.Winston*, 1984
- MPI4Py Documentation - http://mpi4py.scipy.org/docs/usrman/index.html

THANK YOU!

Questions?