Abstract

One of the key determinants of a game playing program's strength is the depth of the game tree search. Therefore, researchers have turned to parallelism to search deeper trees in the same amount of real time. Tree decomposition algorithms extract parallelism by creating split nodes, where the subtrees rooted at the node are searched concurrently. If the game trees are *narrow*, then the degree of parallelism offered by the low branching factor may be insufficient to keep all the parallel processors busy, resulting in starvation and poor speedups.

Chinook is a checkers (8 x 8 draughts) playing program developed at the University of Alberta. For the August 1992, Man Versus Machine World Draughts Championship match between *Chinook* and Dr. Marion Tinsley, a parallel *Chinook,* or *ParaChinook*, was developed. This thesis describes the parallelization of *Chinook*'s Alpha-Beta search.

The initial implementation of *ParaChinook* was based on the Principal Variation Splitting (PVSplit) algorithm, developed by computer chess researchers. However, chess game trees have an average branching factor of 35 to 40, whereas checkers game trees have an average branching factor of 2.84, which is over an order of magnitude smaller. PVSplit exhibits high levels of starvation on the narrow checkers game trees, therefore Principal Variation Frontier Splitting (PVFSplit) is developed. PVFSplit attempts to create more parallel work by allowing multiple split nodes in a variation splitting framework. Although, PVFSplit improves the speedup by 52% (with 16 searchers) compared to PVSplit, the parallel performance is still low in absolute terms.

The parallel performance of both PVSplit and PVFSplit is evaluated using a test suite of 20 positions and running on a BBN TC2000 shared memory multiprocessor. The issues of starvation and straggler processes are discussed, quantified and addressed. The addition of load balancing code to deal with stragglers further improves the speedup. However, it is concluded that any PVSplit-based algorithm will suffer from poor speedups on the narrow checkers game trees. In light of this, some ideas for a future version of *ParaChinook* are discussed.