

## 418 Project Checkpoint

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*Report on how things are progressing relative to the schedule you provided in your project proposal. What work have you completed so far, what adjustments do you need to make to the original schedule and project goals? By the checkpoint, you should have a good understanding of what is required to complete your project. By this point, you should be able to provide a very detailed schedule for the coming weeks. Break time down into half-week increments. Each increment should have at least one task, and for each task put a team member's name on it.*

At this point in our project we are close to completing our sequential implementation of our chess AI program. The schedule created in our project proposal indicates that we would have the sequential implementation done within the first two weeks of the project - however because that goal is not yet complete, we are slightly behind schedule. We have adjusted our schedule accordingly as shown below. We fell behind on our schedule because we underestimated the amount of work it would be to create a working sequential implementation of chess when we were making our project proposal. We are very close to finishing the sequential implementation and should be able to hit the ground running with the parallel implementation(s) on account of the research we have done on parallelization techniques over the past couple of weeks while we have been working on the sequential algorithm.

PROJECT TITLE			Amdhal's Gambit														
WBS NUMBER	TASK TITLE	TASK OWNER	Apr 26					May 3					May 10				
			M	T	W	R	F	M	T	W	R	F	M	T	W	R	F
1	Finish loose ends with sequential portion of the chess AI	Both															
2	Begin integrating concurrency with OMP pragmas	Fausto															
3	Take Metrics on both sequential and OMP implementations	Fausto															
4	Integrate cilk into the chess AI search algorithm	Ryan															
5	Take metrics on the cilk implementation	Ryan															
6	Finish final report	Both															

*Include one to two paragraphs, summarizing the work that you have completed so far.*

We have completed a significant portion of chess gameplay between a user and the computer. First we designed the class for the board and created functionality to initialize, clear, copy the board, get information about pieces on the board, and move pieces around the board. Next we created a class for pieces which is used to view and set information about each piece on the board, such as a piece's type and color. Next we started working on the computer's AI. First we created functions that allow the computer to find all its possible moves for a given chess board. If the computer is to find the best move for any given position, it needs to understand all the possible moves that it can make. We find all these moves by looping over all 64 squares and identifying each piece controlled by the computer. We go through that list of pieces and compile a list of legal moves depending on the type of piece, its position, and the position of other pieces on the board.

We also completed the minimax algorithm which tries to find the move that minimizes the possible loss for a worst case scenario. It works by using information about the board, the depth of search we want, and which color the computer is playing (white or black). The computer uses this algorithm to decide its next move. It works by looping through all possible moves for the current board position and recursively calls the minimax function on the board updated with each move. For each depth level the algorithm descends, it switches which side it is making a move for. By playing out both sides of the board, the algorithm finds the move that maximizes its own position and minimizes opportunities for the opponent to improve their position.

*Describe how you are doing with respect to the goals and deliverables stated in your proposal. Do you still believe you will be able to produce all your deliverables? If not, why? What about the "nice to haves"? In your checkpoint reports, we want a new list of goals that you plan to achieve for the project.*

We believe that even though the sequential portion of the project has been taking some time, we will still be able to reach the goals and deliverables which we previously stated in our proposal. Our previous goals include: creating a sequential chess algorithm, using alpha-beta pruning and parallelizing the search of chess moves. So far we are most definitely set to hit our MVP of implementing a parallelized search algorithm on top of the minimaxing algorithm. In regards to our "nice to haves", we will be working hard to reach an implementation with cilk and hope that we do not run into any huge difficulty. So we will be adding the cilk implementation as one of our goals. Our deliverables will include comparing and contrasting different implementations of the chess AI including the basic sequential algorithm as the controlled implementation which we will base our speedups on. We have cleaned up and reworked our goals we plan on achieving for the project down below.

### Almost Completed

- A working sequential Chess AI which plays against a player while minmaxing scores for its possible moves.
- Successfully use alpha-beta pruning to see speedup from strictly sequential implementation.

### Plan to Achieve

- Search multiple parts of the Chess moves tree (in order to see a speedup in performance) by using OMP.
- Implement a parallel search over the moves tree using cilk.

*What do you plan to present at the end of the course? Charts and graphs? Demonstrations?*

At the end of the course, we plan on presenting graphs depicting the speedups we experienced from our different implementations. Luckily, we will be speeding up our sequential implementation via alpha-beta pruning so we will be able to compare how much speedup we can obtain through parallel optimization versus sequential optimization. This will also give us insight into how worthwhile the parallel optimizations are compared to the sequential improvements we make. At the end of the course we will be able to play against our chess AI and “grade” our chess AI by playing it against different levels of other well-established chess AIs.

*Do you have preliminary results at this time? If so, it would be great to include them in your check- point write-up.*

We do not have preliminary results at this time.

*List the issues that concern you the most. Are there any remaining unknowns (things you simply don't know how to solve, or resources you don't know how to get) or is it just a matter of coding and doing the work?*

We are concerned that it will be difficult to incorporate significant parallelism without losing some performance that comes from the alpha-beta pruning. Alpha-beta pruning uses a depth first approach by going down to the maximum depth, evaluating the board position at this depth and comparing the score to the current best score. It prunes branches it has not fully checked yet if that branch has a score worse than the current best. It also updates the current best if it finds one with a better score than the current best. However, when we parallelize our search for the best move, we check many branches at the same time, meaning if one thread finds a better path than the currently known best path, the other processes may waste time searching branches

that won't produce the best move because their process hasn't received the new information on the best current path found by another parallel process.