Man Versus Machine for the World Checkers Championship

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ABSTRACT

In August, 1992, the World Checkers Champion, Dr. Marion Tinsley, defended his title against the computer program *Chinook*. The best-of-40-game match was won by Dr. Tinsley who scored 4 wins to *Chinook*'s 2 with 33 games drawn. This was the first time in history that a program played for a human World Championship.

1. Introduction

It has been 30 years since Arthur Samuel's pioneering efforts in machine learning gave prominence to checkers playing programs [1, 2]. Samuel's successes included a victory by his program over a "Master" level player. In fact, the opponent was blind and not a Master. This single event, a milestone in artifical intelligence, was magnified out of proportion by the media and helped create the impression that checkers was a "solved" game. Samuel himself had no illusions about his program's strength. Nevertheless, Samuel's work stands as a major achievement for the fledgling field of artificial intelligence. With only a few exceptions (the Duke program being notable [3]), little effort has been devoted to checkers programs since Samuel. Perhaps because of Samuel's early success, most of the subsequent the research efforts into game-playing programs has been dircted towards chess.

Chinook is a checkers program (8×8 draughts) developed at the University of Alberta [4]. In August 1990, the program earned the right to play for the human World

Checkers Championship.

2. The Champion

Since 1950, the checkers world has been dominated by Dr. Marion Tinsley. He first became World Champion in 1954 and then retired from the game in 1958, having vanquished all the best players in the world. He returned to the competetive arena in the early 1970s, and became champion again in 1975. He has been champion since then, successfully defeating all challengers.

Dr. Tinsley's record is unparalleled in checkers, or any other competetive game of skill. Over the past 42 years, he has won every match he has contested, usually by embarssingly large margins. For example, in his 1989 World Championship defense against Paul Davis, Tinsley won 9 games, lost 0, and drew 23, winning the best-of-40 game match by the score of 20.5 - 11.5. He has finished first in every tournament he has played in, again usually by a wide margin. Over this period, comprising thousands of competetive and exhibition games, Dr. Tinsley has lost only 5! He is as close to perfection in checkers as is humanly possible.

Dr. Tinsley has found competetive checkers increasingly boring. His opponents are in awe of his abilities, and play every game to draw. *Chinook* reawkened his interest in the game. The program is not afraid of Tinsley and his reputation, and is willing to make every game a life-and-depth struggle. Tinsley once described his experiences with *Chinook*

3. The Challenger The project began in June 1989 with the short-term goal of developing a program capable of defeating the human World Champion, and the long-term goal of solving the game. In only a year, *Chinook* **has become one of the strongest players in the world.**

In August 1990, *Chinook* competed in its first two human checker tournaments in Tupelo, Mississippi. The program won the Master Section of the Mississippi State Open, going undefeated with 7 wins and 7 draws. This included wins against Grandmasters Richard Hallet and Elbert Lowder (twice). The following week, the program played in the U.S. National Open, the biennial event used to determine a challenger for the World Champion. The event is restricted to Master and Grandmaster players, making it the strongest checkers tournament in the world. The event was of particular interest since the World Champion, Dr. Marion Tinsley, was also competing.

The tournament consisted of 8 rounds, each round being a 4 game match against the opponent. *Chinook* won 4 matches, lost none and drew 4 to finish a clear second. Dr. Tinsley won 5 matches and drew 3 to come first. Grandmasters Richard Hallett and Asa Long (a former World Champion) tied for third place in a field of 34. In round 7, *Chinook* and Tinsley battled to 4 draws. In round 8, *Chinook* defeated Don Lafferty, the second best player in the world, winning one game and drawing the other three. Over both events, *Chinook* scored 4 wins, 0 loss and 8 draws against Grandmasters Tinsley, Lafferty, Hallett and Lowder, 4 of the top 10 players in the world. These results were achieved using an IBM System 6000/530 workstation.

By placing second, *Chinook* has won the right to play a match for the World Checkers Championship. This is the first time a computer program has earned the right to play

for a human World Championship. Programs have played World Champions before, for example *BKG* 9 at backgamman [5] and *Deep Thought* at chess [6], but these were exhibition events with no title at stake. In December, Dr. Tinsley visited Edmonton to make arrangements for the World Championship match against *Chinook*. The match is tentatively scheduled for London, England, probably in November, 1991. Although both the American Checker Federation and English Draughts Association refuse to sanction the match (they do not want machines playing for human titles), Dr. Tinsley has graciously agreed to play.

While in Edmonton, Dr. Tinsley played a 14-game exhibition match against *Chinook*. For Tinsley, it was a chance to find out more about his future adversary. For us, it was a chance to test some new ideas in practice. The final score was a narrow 7.5-6.5 victory for Tinsley, confounding the experts who predicted a more lopsided victory. Tinsley won the 10th game and drew the rest. After the match, Tinsley commented that he was surprised at the quality of *Chinook*'s play. All the weaknesses in *Chinook*'s play that were evident in Tupelo, and which Tinsley had hoped to exploit, were no longer present in the program. He concluded it is hard to play an opponent whose playing style can be changed so quickly.

Tinsley has been the best player in the world since 1950! Intellectual skills, such as those required to play Grandmaster chess or to be a University professor, usually peak by the age of 35 to 40, and experience a decline thereafter. However, of the thousands of tournament and match games played by Dr. Tinsley in the last 40 years, he has only lost 5! He is as close to perfection as one could imagine in a human, and his abilities show no signs of diminishing. In his last World Championship match (June, 1990), Tinsley

defeated Paul Davis of the United States 9-0 with 22 draws. Were checkers a more popular game, Dr. Tinsley would be known world wide. As it is, the popularity of checkers is on the decline and Dr. Tinsley remains a relative unknown, even in his own country.

4. Background

5. Lessons From the Match

Most people assume that because *Chinook* came close to beating Tinsley in 1992, a rematch in 1993 will be in *Chinook*'s favour. Although this is possible, the issue is not quite so clear. From the match, we learned several important lessons that must be resolved before computers will be supreme in checkers.

1) It was obvious in several games that Tinsley could out-search *Chinook*. An extra 2 ply of search (possible with current technology in a year) would reduce the chances of *Chinook* making a mistake. However, major work must be done on selectively searching important lines deeper to reduce Tinsley's advantage. What does this imply for chess, where the *Deep Thought* team confidently expect their faster hardware to propel them to the World Chess Championship?

2) The program can search beyond the resolution of a problem for the opponent, resulting in a move choice that may maximize score, but not maximize practical chances. For example, in game 26, *Chinook* chose a move that preserved a small advanatge which quickly petered out into a draw. The audience expected a different move and thought that *Chinook* was winning. *Chinook* had seen far enough ahead that it could prove that the critical line was a draw. In fact, the draw was quite difficult to

achieve, there being a narrow (and not obvious) line to follow. To solve this problem would require trhe score of alie to reflect the difficulty the opponet would have in finding the correct moves.

3) The biggest weakness of the program is its opening knowledge. There is over 200 years of checkers literature, which Dr. Tinsley has been studying for over 50 years. *Chinook* has been acquiring opening knowledge for only 2 years. Two of *Chinook*'s losses were directly attributable to the openings. In game 5, *Chinook* followed a line in its opening book taken from one of the major books on the checkers openings. Unfortunately, we only found out after the match that the author of the book admits the line is bad and should never have been included in his book. Before the match, *Chinook* had analyzed the line with 19-ply searches and did not see any problems with it In game 25, Tinsley transposed moves, tricking *Chinook* to get out of its opening book prematurely. *Chinook* was unable to find the corret move in a difficult position and lost.

4) Verifying the checkers opening literature is difficult. All positions in *Chinook*'s opening book had been verified with 19-ply searches. Unfortunately, some moves require considerably more depth to uncover their secrets.

5) It is beoming increasingly important to differentiate between drawing lines. The endgame databases allows *Chinook* to quickly back up draw scores to the root of a search. In game 38, the program announced a draw on move 5 of the game! Given that the game is drawn, *Chinook* must be able to choose amoungst the drawing moves the one that gives the opponent the most chances to go wrong.

Some of these problems are quitre difficult to solve. However, it is clear that these

problems will also have to one day be addressed by the computer chess community.

Finally, there is one lesson that is rather obvious but is worth mentioning. The human spirit, when confronted with a challenge, is capable of putting forth the extra effort to raise their abilities b eyond what they are normally capable of. As *Chinook* grows in strength, we beleive Dr. Tinsley's abilities will grow to match ours.

6. The Match

The match was played at the Park Lane Hotel, August 17-29, 1992. Silicon Graphics International sponsored the event, and provided a SGI 4D/480 for *Chinook* to run on (8 30-mip processors, 256 MB of RAM, 3 GB of disk). David levy, Raymond Keene and Tony Buzan were the match organizers.

Dr. Tinsley won the match, winning 4 games, losing 2 and drawing 33 in the best-of-40-game match. Several of the game hilights included games:

Game 1:Dr. Tinsley pressed for 5 hours trying to win a superior endgame. His efforts were futile, since the endgame was in *Chinook*'s databases and it knew how to draw the game.

Game 2:*Chinook* came up with a new move in the opening that the spectators labelled as "ugly", but turned out to be quite strong. Tinsley defended accurately and the game was drawn.

Game 5:*Chinook* followed a line from its opening book taken from an authoratative book on the checkers opening. At the end of the line, the program may have been lost. The author of the book admits that the line is bad and should never have been

included in his book! *Chinook* walks along a tightrope and finally slips. In the critical position, 2 ply more of search find the draw. Dr. Tinsley leads 1-0.

Game 7:A weak move in the opening by *Chinook* leads to a long-term advantage for the Champion. At the critical junction, Dr. Tinsley rejects the winning move, incorrectly analysing it to a draw. Tinsley does not get another chance and the game is drawn.

Game 8:*Chinook* plays a complicated opening and on move 10, Tinsley is faced with a dilemma. He has a choice of a move that simplifies the position and ends the complications, or a move that increases the tension. Knowing that computers excell in complications, Tinsley tries simplifying and discovers on the next move that he is in trouble. *Chinook* plays a perfect game to notch up the win. The match is tied 1-1.

Game 14:*Chinook* plays an unusual opening line, forcing Dr. Tinsley to recall 30 year old analysis. Eventually he makes a mistake and the program sacrifies a checker to get a king. *Chinook*'s king harassess Tinsley's men and forces him into a bad endgame. When Dr. Tinsley resigned, the spectators rushed up on stage and congratulated him on drawing a difficult game. *Chinook* leads 2-1.

Game 18:On move 17, in a drawn position, *Chinook* freezes. Some sort of deadlock situation arises and the program is unable to make its next move. The program forfeits the game. The match is now even 2-2.

Game 25:Dr. Tinsley inadvertently transposes moves and *Chinook* is out of its opening book in a difficult position. On move 10, the program makes the decisive mistake and Dr. Tinsley flawlessly concludes the game. Tinsley leads 3-2.

Game 26:Tinsley appears to be in trouble in this game, and many spectators thought he

was lost. In fact, he had seen through all the complications and found the only route to a draw.

Game 31:*Chinook* gets into trouble early and struggles hard, eventually finding the draw in a game most people (including TinsleY) thought was lost.

Game 39:In a do-or-die situation, *Chinook* spurns a safe draw to keep the game alive. In the resulting endgame, Tinsley outplays the program and wins. Final score: 4-2 for Dr. Tinsley.

7. Analysis of the Results

8. Conclusions

Can *Chinook* defeat Tinsley in 1993? This is a hard question to answer. Although it seems inevitable that a computer program (not necessarily *Chinook*) will exceed human capabilities in checkers, it is not clear when this will take place. Although *Chinook* has a strong claim to be the second strongest checkers player in the world, it will be difficult to wrest the title away from Dr. Tinsley.

Ackknowledgements

References

References

1. A.L. Samuel, Some Studies in Machine Learning Using the Game of Checkers, *IBM Journal of Research and Development 3*, 3 (1959), 210-229. See also (1963), *Computers and Thought*, E.A. Feigenbaum and J. Feldman (eds.), McGraw-Hill,

pp. 71-105.

2. A.L. Samuel, Some Studies in Machine Learning Using the Game of Checkers II - Recent Progress, *IBM Journal of Research and Development 11*, 6 (1967), 601-617.

3. T. Truscott, The *Duke* Checkers Program, Duke University report, 1978.

4. Jonathan Schaeffer, Joseph Culberson, Norman Treloar, Brent Knight, Paul Lu and Duane Szafron, A World Championship Caliber Checkers Program, *Artificial Intelligence 53*, 2-3 (1992), 273-290.

5. H. Berliner, Backgammon Computer Program Beats World Champion, *Artificial Intelligence 14*, (1980), 205-220.

6. D. Kopec, Advances in Man-Machine Play, in *Computers, Chess and Cognition*, T.A. Marsland and J. Schaeffer (ed.), Springer-Verlag, New York, 1990, 9-32. In press.