WORLD COMPUTER CHESS CHAMPIONSHIP

AGT

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A SHORT HISTORY OF COMPUTER CHESS†

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Review

Of the early chess-playing machines the best known was exhibited by Baron von Kempelen of Vienna in 1769. As might be expected, these were conjurer's tricks and grand hoaxes [1, 2]. In contrast, about 1890 a Spanish engineer, Torres y Quevedo, designed a true mechanical player for king-and-rook against king endgames. A later version of that machine was displayed at the Paris Exhibition of 1914 and now resides in a museum at Madrid's Polytechnic University [2]. Despite the success of this electromechanical device, further advances on chess automata did not come until the 1940's. During that decade there was a sudden spurt of activity as several leading engineers and mathematicians, intrigued by the power of computers and fascinated by chess, began to express their ideas on computer chess. Some, like Tihamer Nemés of Budapest [3] and Konrad Zuse [4], tried a hardware approach but their computer chess works did not find wide acceptance. Others, like noted computer scientist Alan Turing, found success with a more philosophical tone, stressing the importance of the stored program concept [5]. Today, best recognized are the 1965 translation of Adriaan de Groot's 1946 doctoral dissertation [6] and the much referenced paper on algorithms for playing chess by Claude Shannon [7]. Shannon's inspirational work was read and reread by computer chess enthusiasts, and provided a basis for most early chess programs. Despite the passage of time, that paper is still worthy of study.

Landmarks in Chess Program Development

The first computer model in the 1950's was a hand simulation [5]; programs for subsets of chess followed [8] and the first full working program was reported in 1958 [9]. By the mid 1960's there was an international computer-computer match [10] between a program backed by John McCarthy of Stanford (developed by a group of students from MIT) and one from the Institute for Theoretical and Experimental Physics (ITEP) in Moscow [11]. The ITEP group's program (under the guidance of Georg Adelson-Velskii) won the match, and the scientists involved went on to develop Kaissa*, which became the first world computer chess champion in 1974 [12]. Meanwhile there emerged from MIT another program, Mac Hack Six [14], which boosted interest in Artificial Intelligence. First, Mac Hack was demonstrably superior not only to all previous chess programs, but also to most casual chess players. Secondly, it contained more sophisticated move ordering and position evaluation methods. Finally, the program incorporated a memory table to keep track of the values of chess positions that were seen more than once. In the late 1960's, spurred by the early promise of Mac Hack, several people began developing chess programs and writing proposals. Most substantial of the proposals was the twenty-nine point plan by Jack Good [15]. By and large experimenters did not make effective use of these works, at least nobody claimed a program based on those designs, partly because it was not clear how some of the ideas could be addressed and partly because some points were too naive. Even so, by 1970 there was enough progress that Monroe Newborn was able to convert a suggestion for a public demonstration of chess playing computers into a

† This article is a condensed and revised extract from the chapter "Computer Chess Methods", Encyclopedia of Artificial Intelligence, S. Shapiro (editor), Wiley 1987.

* The names of programs mentioned here will be written in italics. Descriptions of these programs can be found in various books [12, 13].
competition that attracted eight participants [16]. Due mainly to Newborn's careful planning and organization this event continues today under the title "The ACM North American Computer Chess Championship," and is sponsored by the Association for Computing Machinery (ACM).

In a similar vein, under the auspices of the International Computer Chess Association, a worldwide computer chess competition has evolved. Initial sponsors were the International Federation for Information Processing (IFIP) triennial conference in Stockholm (1974) and Toronto (1977), and later independent backers such as the Linz (Austria) Chamber of Commerce (1980), ACM New York (1983), the city of Cologne (1986), West Germany, and for 1989 AGT/CIPS, Edmonton. In the first world championship for computers *Kaiissa* won all its games, including a defeat of *Chaos* after it had won against the favourite. An exhibition match against the second place finished the 1973 North American Champion, *Chess 4.0*, was drawn [10]. *Kaiissa* was at its peak, backed by a team of outstanding experts on tree searching methods. In the second Championship (Toronto, 1977), *Chess 4.6* finished first with *Duchess* and *Kaiissa* tied for second place. Meanwhile both *Chess 4.6* and *Kaiissa* had acquired faster computers, a Cyber 176 and an IBM 370/165 respectively. The traditional exhibition match was won by *Chess 4.6*, indicating that in the interim it had undergone far more development and testing [17]. The 3rd World Championship (Linz, 1980) finished in a tie between *Belle* and *Chaos*. In the playoff *Belle* won convincingly, providing perhaps the best evidence yet that a deeper search more than compensates for an apparent lack of knowledge. In the past, this counter-intuitive idea had not found ready acceptance in the Artificial Intelligence community.

At the 4th world championship (New York 1983) yet another new winner emerged, *Cray Blitz* [18]. More than any other, that program drew on the power of a fast computer, here a Cray X-MP. Originally *Blitz* was a selective search program, in the sense that it could discard some moves from every position, based on a local evaluation. Often the time saved was not worth the attendant risks. The availability of a faster computer made it possible to use a purely algorithmic approach and yet retain much of the expensive chess knowledge. Although a mainframe won that event, small machines made their mark and seem to have a great future [19]. For instance, *Bebe* with special purpose hardware finished second, and even experimental versions of commercial products did well. The most recent 1986 event was also exciting. *Hitech* seemed to dominate, but faltered in a better position against *Cray Blitz* allowing a four-way tie for first place. As a consequence an unknown micro-processor system, *Rebel*, nearly took it all, but in the end failed to clinch its final round game.

For the past two decades Canadian participation has been active and successful. Two programs, *Ostrich* and *Wita*, were at the inauguration of computer chess tournaments (New York 1970), and their authors went on to produce and instigate fundamental research in practical aspects of game-tree search [20-27]. Before its retirement, *Ostrich* (McGill) participated in more championships than any other program. Its contemporary, renamed *Awit* (Alberta), had a chequered career as a Shannon type-B (selective search) program, finally achieving its best result with a second place tie (New York 1983). Other successful programs were *Ribbit* (Waterloo), which tied for second in Stockholm (1974), *L'Excentrique* (McGill) and *Brute Force* (Manitoba). Currently the strongest Canadian program is *Sun Phoenix* (Alberta), a multiprocessor based system using work stations. In Cologne (1986) *Sun Phoenix* tied for first place with three others and hopes to do even better in its home town.

Implications

All this leads to the common question: When will a computer be the unassailed expert on chess? This issue was discussed at length during a panel discussion at the ACM 1984 National Conference in San Francisco. It is too early to give a definitive answer, even the experts cannot agree; their responses covered the whole range of possible answers from "in five years" (Newborn), "about the end of the century" (Scherzer and Hyatt), "eventually. - it is inevitable" (Thompson) and "never, or not until the limits on human skill are known" (Marsland). Even so there was a sense that production of an artificial Grand
Master was possible, and that a realistic challenge would occur during the first quarter of the 21st century. As added motivation, Edward Fredkin (MIT professor and well-known inventor) has created a special incentive prize for computer chess. The trustee for the Fredkin Prize is Carnegie-Mellon University and the fund is administered by Hans Berliner. Much like the Kremer prize for man-powered flight, awards are offered in three categories. The smallest prize of $5000 was presented to Ken Thompson and Joe Condon, when their Belle program earned a US Master rating in 1983. The second prize of $10,000 for the first program to achieve the equivalent of a Grand Master norm is to be awarded to Deep Thought later this summer, but the $100,000 for attaining world champion status remains unclaimed. To sustain interest in this activity, each year a $1500 prize match is played between the currently best computer and a comparably rated human.

One might well ask whether such a problem is worth all this effort, but when one considers some of the emerging uses of computers in important decision-making processes the answer must be positive. If computers cannot even solve a decision making problem in an area of perfect knowledge (like chess), then how can we be sure that computers make better decisions than humans in other complex domains -- especially in domains where the rules are ill-defined, or those exhibiting high levels of uncertainty? Unlike some problems, for chess there are well established standards against which to measure performance, not only through the Elo rating system but also using standard tests [28] and relative performance measures [29]. The ACM sponsored competitions have provided nearly twenty years of continuing experimental data about the effective speed of computers and their operating system support. They have also afforded a public testing ground for new algorithms and data structures for speeding the traversal of search trees. These tests have provided growing proof of the increased understanding about chess by computers, and the encoding of a wealth of expert knowledge. Another potentially valuable aspect of computer chess is its usefulness in demonstrating the power of man-machine cooperation. One would hope, for instance, that a computer could be a useful adjunct to the decision-making process, providing perhaps a steadying influence, and protecting against errors introduced by impulsive short-cuts of the kind people might try in a careless or angry moment. In this and other respects it is easy to understand Donald Michie’s view that computer chess is the "Drosophila melanogaster [fruit fly] of machine intelligence" [30].

References