World Chess Championship Computer

As a spectator sport, computer chess can be rather boring. The developers of Chess 4.6 are coming up with an innovative method of making it much more interesting!

Theodore Ehora

A classic confrontation, along the lines of the Fischer-Spassky match, was anticipated in the World Computer Chess Championship that took place in Toronto in 1977. Although there were sixteen entries, representing eight countries, excitement was generated by the expected clash between Chess 4.6, a Northwestern University program from Evanston, Illinois that was authored by Lawrence R. Atkin and David J. Slate, and Kaissa, the Soviet program created by a ten-man team from the Institute of Control Sciences in Moscow.

Kaissa, named after the mythical goddess of chess, was the defending champion, having scored four straight wins at the first championship that took place in Stockholm during August of 1974. Three years later in Toronto, Kaissa was meeting its first serious competition since it had won the title. The Russians, because of their great popular enthusiasm for the game, had programmers working full time to develop their electronic champion.

In contrast, Chess 4.6 was a spare time hobby for its two authors. Its most recent achievements before the Toronto tournament ranged from winning the Minnesota Open (for humans) to winning the U.S. Computer Chess Championship. It had been improved since losing the first world championship, then named Chess 4.1, but it was unknown whether these innovations could beat Kaissa.

In the first round of the tournament the unexpected happened. Kaissa faced Duchess, a chess playing program from Duke University. Duchess beat the Soviet program after 48 moves. Although Kaissa pulled itself together and defeated the rest of its opposition, it was still beaten by Chess 4.6, which defeated all its opponents and won the title.

An exhibition game between Kaissa and Chess 4.6 only added salt to the Soviet wound. Kaissa lost that game after 44 moves.

Winning the computer chess championship was the last thing on the mind of David Slate, as he walked through Northwestern's computer center in the summer of 1968. Slate, a graduate student in physics, was in the systems bay area when he noticed a green binder with the word "CHESS" printed on it. The authors of this chess program were Lawrence Atkin and Keith Gorlen (who has since left the project). Both Atkin and Gorlen were undergraduate students in computer science. Atkin describes his original reason for writing a chess program as a means of escaping the boredom of being a student. They had written their first program in April 1968. At the time, both of them were relatively weak players.

Slate who was an expert player, decided to write his own program and by September, 1968, Northwestern had two chess playing programs. Each of these programs had their own strengths and weaknesses. The Atkin-Gorlen program had a primitive tree search function, which allowed the computer to look ahead in moves. It also had a bad judgment of the resulting positions. Slate's program was just the opposite; it made good evaluations of the game, but was weak in looking ahead.

In 1969 Slate told Atkin that he had decided to write another program. Atkin replied that they should combine their two programs, since each of them had separate strengths and talents that they could bring to the project. The resulting program was eventually named Chess 2.0.

As they began to write their new program, they also became aware of the literature on computer chess. The new program implemented alpha-beta pruning, which greatly increased the playing strength of the program.

"I remember this scene at the console," recalled Slate, as he described the first test game of the new program. "Atkin was playing the program. It (the program) was really playing chess. Playing very sharp, very nicely. It acted as if it knew what was going on on the chess board. Punishing mistakes ruthlessly.... and at the very last moment, when it had one move to go to checkmate Atkin—of course he was quite ecstatic over this experience; the monster we had created had come to destroy us. It was just thrilling!"—suddenly when it was going to checkmate him, the display started to go completely berserk. Weird numbers appeared on the screen; fizzing and sparkling started and then it dissolved. "The program had died a horrible death; the strain was too much. Its first victory was too much for it."

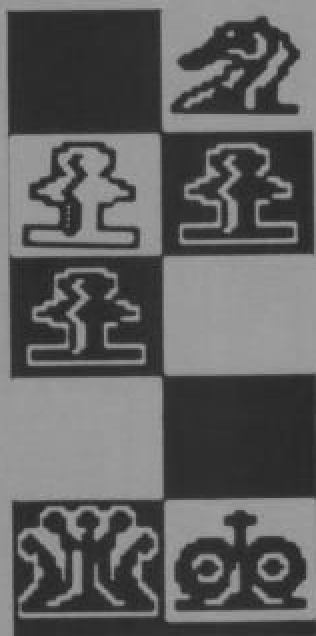
Eventually they discovered the flaw in the program. They had told the computer that it could only have fifty legal moves in one position. However the checkmate position was complex and there were over fifty legal moves available.

After play-testing their new program, they began to distribute it to various computer installations. Because the software products were usually advertised with a number after it, they decided to call it Chess 2.0. Why did they call the first version 2.0 instead of Chess 1.0?

"We wanted everyone to think they had missed the first version," said Slate, with a chuckle.

"We, on the inside, know just how flaky the whole set-up is," remarked Slate, as he described Chess 4.6, with its house language program of over 30,000 steps. "We have a certain sense that a human would make moves at a certain level, but that is not reasonable to assume for a computer. It's metal and semiconductors with electric currents running around inside. Every one of those things had to be perfect in order for it to play."

Indeed, the idea of a chess playing computer seems absurd if you look at the statistics of this complex game. According to Claude Shannon, a computer scientist whose 1950 paper pioneered computer chess, there are 10^{120} different sequences of moves that begin with the initial position of the



game. He indicated that a fast computer would take 10^{90} years to examine all the possible moves, before the first move is made.

Since all serious tournament play is timed, any chess playing computer would lose the game by exceeding the time limit if it was programmed to look at all the possible variations in a position. So how do you get a computer to "think" through a game of chess?

Chess 4.6 analyses an average of three moves ahead. Since one move by the computer can result in a variety of responses by its opponent, the computer must numerically evaluate all the resulting positions, then combine these results to assign a numerical evaluation to the contemplated move. This evaluation will reflect whether the move is more favorable for the computer or its opponent. Finally, the computer will choose the move which has a numerical evaluation that gives it the most favorable position from the possible selection of moves. The evaluation of a position considers such things as material advantage, pawn structure, king safety and mobility.

Occasionally, the computer will reject a certain move after it discovers a bad position could arise from that move. This saves the computer from wasting time in investigating useless variations.

Many of the opening moves of the game have been investigated by human players. Openings from the quiet "Giuoco Piano" to the dynamic "Sicilian" are programmed in the computer and played by rote for the first six to fifteen moves. After that, the computer begins to "think" about the position. Presently, Chess 4.6 holds over 6,000 different opening positions in its memory bank.

Chess players are categorized in classes by the United States Chess Federation, in ascending order, as E,D,C,B,A, expert, master and senior master, with class "C" being an average tournament player. The World Chess Federation bestows the higher titles of International Master, Grandmaster and World Champion, which are earned by international competition. Both Slate and Atkin rate Chess 4.6 as an expert. Atkin noted that the program plays better than either one of its creators.

"The problem of trying to rate a computer is that computers really play a different game of chess than people do," stated Atkin. "What happens is that the machine plays tactics like a Grandmaster and makes strategic moves like an 'E' class player. You end up with something in the middle."

Another interesting difference between man and machine is the fact that a chess master will often play an inferior move, gambling that his opponent will not be able to exploit it. The computer assumes its opponent will find the proper reply to all its moves.

This difference between computer and man continues to challenge Atkin and Slate. Already they have added a new innovation which allows Chess 4.6 to analyze its opponent's probable move while the opponent is thinking. Now, they hope to devise a way for the computer to build a hypothetical model of its opponent's play. By using such a model, the computer could probe its opponent's weaknesses and play a gambling move.

J.BIIT was the name of a program devised by chess master Hans Berliner. In that name he stated the basic purpose for programming a chess playing computer: Just Because It Is There. However, practical purposes for the chess playing program have already been found. Presently, the specific techniques used for playing chess have already been used in programs that handle a telephone-switching system and an electronic-power grid.

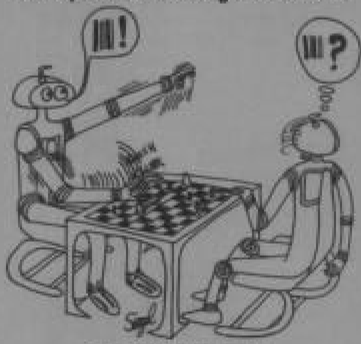
"It is a good research base," said Atkin. "If you're interested in how to make computers solve difficult problems, language translation problems, perception problems.... those kinds of problems are very difficult because there are enormous amounts of data and a huge information base. One example would be language translation problems which deal in huge vocabularies. Those are difficult problems, but they are basically similar to chess. So chess can be used as a simple problem to help solve the more difficult ones in the field of artificial intelligence."

While the future for computer chess and its practical applications looks promising, the immediate future holds plenty of challenge for Chess 4.6. Perhaps the most dramatic of these challenges is the Levy wager.

In 1968 David Levy, an International Master and computer expert, wagered that he couldn't be beaten by a chess playing computer in a ten-game match. The bet is presently for 1,250 pounds sterling (about $2,125) and has been placed with three computer scientists. Although the time limit for the bet is August, 1978, Levy has indicated that he will renew the wager after that period.

"The bet was made by Levy with three computer scientists," explained Atkin. "It is up to them to come up with a program—steal, borrow or whatever—that will play Levy. We've tenatively agreed to be that program. Right now there are negotiations going on trying to arrange the location for the match."

"One way to beat him is with a conceptual breakthrough. What we've found is that if we put our program on faster machines, its play is significantly better. (Presently Chess 4.6 is run on a CDC Cyber 176. A six-fold increase in speed gives the computer an extra half-move to look ahead.) If there is another step, another order of magnitude in the power of machines, I think that we can—well, its hard to say. I think we can beat him once in a while—that is better than I think we can do now, which is almost never."



ONE DAY AT THE FIRST ROBOTIC CHESS TOURNAMENT

Presently Atkin and Slate, along with David Cahlander of Control Data, are busy finding ways to improve Chess 4.6. One of their most recent plans is a way to cut down on the boredom of attending the program at a tournament.

"Actually, when you have a terminal, its a drag," said Atkin. "You're sitting there, with the board in front of you and the terminal on your side. The computer makes a move. You make it on the board. You sit there twiddling your thumbs while the other guy (or computer) is thinking. He makes a move. You type it in the terminal. You're just an automaton, sitting in the middle. Getting very frustrated ... it's nervewracking."

"What we're trying to do right now is build a robot that takes the place of the programmer sitting between the terminal and the board. The robot will have an arm that picks up the pieces. We'll just sit back and watch." ■