PENNSYLVANIA STATE CHESS CHAMPIONSHIP

HITECH Becomes First Computer Senior Master

Hitech wins the Pennsylvania State Chess Championship.

The Pennsylvania State Chess Championship was held in Pittsburgh, on July 23-24. In a field of 46 players, including 8 masters, Carnegie-Mellon University's Hitech won the title outright with a score of 4.5 - 0.5. The finale was very exciting as the number one seeded player, International Master Ed Formanek, had a perfect 4-0 going into the final round against the number two seed Hitech, which was the only competitor with 3.5 - 0.5. Hitech had to win to gain the title, whereas Formanek could become Champion by drawing this game. Hitech played beautifully, and the game culminated in a brilliant endgame that Hitech handled perfectly. The game is appended below.

Hitech also finished first in last year's State Championship, but after the fact a number of issues arose relating to whether the computer could be the State titlist. This year the rules specified that a computer could win the title. So Hitech received the title, but was not eligible for the $400 first prize money and was not supposed to get the trophy either. However, in a fine gesture of sportsmanship, Professor Formanek of the Mathematics Department of Pennsylvania State University, presented the trophy he had won to Hitech since he indicated Hitech clearly deserved it. Formanek was one of four Masters that ended tied for 2nd at 4-1.

This is the first time Hitech has won a noncomputer tournament outright; that is, without sharing 1st place. Formanek, rated at 2485, is the highest rated player Hitech has ever beaten. It is the first time that Hitech has beaten an IM, and we believe only the second time that a machine has beaten an IM (Fidelity beat an IM).

We estimate Hitech's new rating to be 2405; so it has crossed the magical 2400 boundary and is now a Senior Master in the U.S. Chess Federation. It is the first computer to achieve this title. The above are subject to verification by the USCF; however, in the past our calculated ratings have never differed from the USCF's by more than 2 points. This advance also places Hitech among the top 150 players in the U.S. Hitech's performance rating was 2507.

In tournaments since the National Open, Hitech had a mediocre result of 3.5 - 2.5 at the Fredkin Masters Open in Pittsburgh, May 28-30. Over the 4th of July holiday, Hitech competed in the World Open, Masters Section. The field was made up of 127 players, almost all of them Masters. Hitech scored 5.5 - 2.5 and finished tied for 10th. It lost its last round game, when winning would have meant tying for 1st.

It seems appropriate to indulge in a little retrospection at this point. The first program that was able to play chess at a level that could be measured on the National rating scale was Greenblatt's MacHack-VI. It achieved a rating of about 1440 (Class C) in the 1966-1967 time period. In the period 1970 - 1979, the Northwestern University program CHESS4.X dominated the scene. Early versions of this program, by David Slate and Larry Atkin, performed at approximately the 1600 level (Class B). When the CDC CYBER 176 came along, CHESS4.6's rating moved up dramatically to the vicinity of 1900 (Class A). In 1980, Ken Thompson and Joe Condon of Bell Labs built the special purpose computer Belle. It immediately assumed the lead and eventually became a Master and set a new high water mark for computers of 2203.

Belle was dominant until 1983.

Cray Blitz took over winning the computer tournaments at this point; however, it was never able to do much with respect to the human rating scale, something that we attribute to the rather poor knowledge in that program. Beginning in 1985, Hitech started setting new records. In October, 1985 Hitech eclipsed the old record for computers by achieving a 2233 rating. By December, the rating had been pushed to 2301. By July, 1986 Hitech's rating reached 2359. However, a great deal of this was due to opponent's failing to treat Hitech with appropriate respect, and throwing away winning positions with careless play. The present high has been achieved some 22 years after the 1966 MacHack-VI rating was established. It corresponds to a gain in rating of 965 points, or approximately 45 points/year. This figure has also been arrived at by other analysts.

However, as the above shows, progress has not always been continuous. If the present rate of progress continues, then we can expect a computer as World Champion by the year 1998. It is very difficult to predict exactly what is required to do this. New and very promising search algorithms are now appearing. Also, new hardware already has made possible speeds 6 times greater than Hitech's in a single chip. However, it appears that the very best players will continue to find weaknesses in computer play until most of the chinks in the knowledge armor are eliminated.

The fact that it has taken 30 months to go from 2301 to the present 2405 can be attributed to several factors: The basic capability of a machine is definitely related to its speed and the depth to which it can search. Thus, as long as a machine cannot outsearch a class of human opponents, it will likely remain inferior to that class. At the moment Hitech can be outsearched by players in the class 2500+.

As we learned more about the pattern recognition process, we decided to rebuild our pattern recognizers. This resulted in improvement in the play, but also in the loss of about one year of time, considering time to build and install, and then to debug the resulting configuration.

Opponents are much tougher than they were before. About 1/3 of all players exercise their option to refuse to play computers. Of the remainder, about 80% seem well prepared to play Hitech. It is no longer unusual to find people talking in the playing halls about what they believe to be Hitech's weaknesses. We have encountered players who openly say that they have collected and studied all of Hitech's games that they could find, in case they had the opportunity to play it in the future.

The first and third reasons above produce a slowing down of visible progress. However, it allows Hitech's developers to find those weaknesses that need to be fixed. Recently, Hitech has managed to produce ever better quality games and to continue to raise its rating as the result of improving its knowledge and searching capability (but not speed). It is appropriate here to give credit to those who have made this possible: Carl Ebeling (now at University of Washington) built the special purpose hardware (Ebeling 1985), and a good deal of software relating to how to interface to the hardware and see what it is doing for debugging purposes.

Larry Slomer (now at PPG Industries) helped to build the hardware and maintained it after Carl graduated.

Gordon Goetsch wrote most of the system software that makes possible interfacing with the special purpose hardware, and has recently revised the software that supervises the search to make other searching disciplines possible. Gordon also maintains Hitech's statistics.

Murray Campbell has helped with the opening book, and has now implemented the "Singular Search" (Anatharam 1988) algorithm on Hitech. He has been my alter-ego when it comes to discussion of chess ideas, and what can be done to allow Hitech to understand this or that.

Andy Palay has been involved with early design issues, and recently had implemented the opening book in the form of a file system that allows greater ease of access, and modification.

Andy Gruss has now taken over responsibility for the hardware and is designing some new units at the present time.

I have been responsible for doing the pattern knowledge (Berliner 1988) and most of the opening book, and acting as moderator for the many fine discussions that we have about how to improve Hitech in the various areas that need work.

Since August 1987, when Hitech was reborn with new pattern recognizers and properly working software, it has played 48 US rated games and 4 games in International matches. Its US performance rating over this period is 2440. In two matches earlier this year, it beat M. Peretz of Israel 1.5 - 0.5, and drew M. Apicella of France 1-1. A summary of these results by category of player can be found below:

Expert or less (<2200):	15 - 0
Master (2200-2399)	14.5 - 6.5
Sr. Master (2400-2499)	3 - 1
Top 50 US	1 - 7
Foreign	2.5 - 1.5

Pennsylvania State Championship, Pittsburgh, July 24, 1988.

White : IM Formanek (2485)
Black : Hitech (2385)
1. e4, e5;
2. Nf3, Nc6;
3. Bb5, a6;
4. Ba4, Nf6;
5. O-O, N:e4;
6. d4, b5;
7. Bb3, d5;
8. N:e5
The most popular move here is 8. d:e5 which keeps the Black N at c6 blocking its own pawn. I suspect our opponent wanted to avoid well trodden paths that Hitech may have had much information on.
8., N:e5;
9. d:e5, c6;
10. Nd2,
Now Hitech is out of its book, and on its own.
10.,Nc5;
11. Nf3, Be7;
12. c3, N:b3;
13. a:b3, O-O;
Here Hitech had to judge whether to play it safe with 13.-- Bg4 which restricts the N from any useful activity, or to allow what follows. It judged the sequel correctly.

14. Nd4, Bd7;
15. b4, a5!;

White is trying to blockade the c-pawn by getting a N or B into c5, by Nb3 and Be3 followed by Bc5. Hitech understands such things, and adeptly foils all of White's attempts.

16. R:a5, R:a5;
17. b:a5, Q:a5;
18. b4, Qa2;
19. Be3, Qc4!;

Gaining time for the eventual c5 by attacking the pawn at c3.

20. Qa1, c5;
21. b:c5, B:c5;

Black stands better. After White's inferior next move, Hitech wins a P.

22. h3?, Re8!;
23. Nf3,

After 23. f4, f6 wins a P; and after 23. Bf4,b4 also wins one.

23.,B:e3;
24. f:e3, Qc5!;
25. Qe1, Rc8;
26. Qf2, Be8;
27. Nd4, Q:c3;
28. N:b5!, Q:e5;

Of course, not 28.-- B:b5; Q:f7+,Kh8; Qf8+ and mate next move. Despite the fact that Black is a P ahead, this position should be drawn. The reason is that White's N is very strongly placed inhibiting the movement of Black's pieces, whereas Black's B is unable to find effective targets.

29. Nd4, Rc3;
30. Re1, Bd7;
31. Qf3, Bc8;
32. Kf2, f6;
33. Ra1, Bb7;
34. Rb1, Rc7;
35. Rb6, Kf7;
36. Re6, Qg5;

Both sides have been jockeying around without any clearly defined aims. I was beginning to get concerned that Hitech would mess things up; however, it is Formanek that cracks. His next move allows the swap of the major pieces, which makes it possible for the Black K to participate in the fight. Then Black has real winning chances.

37. Qg3??, Rc2+!;
38. N:c2, Q:g3+;
39. K:g3, K:e6;
40. Nd4+, Ke5;
41. Kf3, h5!;
42. h4?,

Post-game analysis revealed that White could probably still hold the position by not moving any of his pawns. Usually, in such situations it is correct to keep your pawns on the opposite color as your opponent's B. However, here it weakens the square g4 over which the Black K will eventually infiltrate. I would have made the same move under the circumstances, but it is wrong. Black can now win by force, and does.

42., g5!;
43. g3, Bc8;
44. Nc6+, Kd6;
45. Nd4, Bg4+;
46. Kf2, Ke5;
47. Nb5, Bd7;
48. Nd4, Ke4;
49. Nc2, Bb5;
50. Nd4, Ba6;
51. Ne6, Bc8;
52. Nd4, Bd7;
53. Nc2, g:h4!;

The critical decision. Now White has two weak pawns and the Black king will jockey around to win one of them. The resulting ending with two pawns ahead is then an easy win.

54. g:h4, Bg4;
55. Nd4, f5!;

A strange looking move that puts another P on the same color as his own B, which is a no-no in such situations. However, as Hitech has foreseen, this is only temporary, and the move is actually the start of a profound winning maneuver.

56. Ne6, f4!;

The blockbusters start. If now 57. N:f4,d4!; Ng2 (N:h5,d:e+ preserving the last P, wins), d3; Ke1,Bf3 wins.

57. Nc5+, Kf5;
58. Nd3, d4!!;

Hitech had been playing very quickly, but I was unprepared for this shot which it made after only 16 seconds of reflection. If now 59. N:f4, Ke4 wins as before. If 59. e:f, Ke4 winning the f-pawn and leaving Black with an easier win than in the game, because the Black d-pawn is further removed from the scene of action and thus more dangerous.

59. e:d4, Ke4;
60. Ne5, K:d4;
61. Nf7, Be6;
62. Ng5, Bd5;

Now the Black K goes over and leisurely wins the White h-pawn. It is impossible for the White K and N to stop the two Black pawns, though this is not immediately obvious.

63. Nh3, Ke4;
64. Ng1, Kf5;
65. Ne2, Kg4;
66. Kg1, f3;
67. Nc3, Bc6;
68. Kf2, K:h4;
69. Nd1, Kg4;
70. Ne3+, Kf4;
71. Nf1, h4;
72. Nh2, h3;

If White did not have to move, he could draw the game by just keeping his pieces where they are and Black would not be able to advance either P. However, unfortunately for him, he is in Zugzwang (the compulsion to move). Hitech had already been predicting values of more than a R ahead for some time.

73. Nf1, Bb5;
74. Ng3, h2;
75. Nh5+, Kg4;
76. Ng3, Bf1!;

Not absolutely necessary, but nice. The B cannot be taken, and if 77. Nh1, Bg2; Ng3,Kh3 and everything falls apart. Therefore:

White Resigns

References

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