David Levy watches the computer moves at the ACM chess tournament.

# The Levy Wager

## Theodore H. Ehara

*The world-famous chess champion, David Levy, has met and beaten his first computer opponent. In five years his skill is scheduled to be put to the test again with another match. Who will be the final Chess Master... the human, the programmer, or the computer?*

In the summer of 1968, an informal chess game was played between John McCarthy, a professor of Artificial Intelligence at Stanford University and David Levy, then Scottish Chess Champion. Upon losing the game, McCarthy remarked that Levy was the stronger player, but added that a computer program would beat Levy in a match withing the next ten years. A bet of five hundred pounds sterling (then $1,250) was made between Levy and McCarthy.

**By 1975, Levy reported that he felt the two strongest programs were the Northwestern program and Kaissa, a Russian program.**

During that same summer, David Slate, a graduate student in high energy physics, was walking through Northwestern University's computer center. Slate was an expert rated chess player. Although he had programmed computers to play simple games, he balked at programming a computer to play chess, because of the tremendous amount of instructions needed to obtain even a bad chess playing computer. As he walked through the systems bay area, he noticed a binder with the simple title of "CHESS" on it. The binder contained a chess playing program that was the combined work of two undergraduate students, Keith Gorlen and Larry Atkin.

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Photos by David Ahl.

In the years that followed that summer, Levy kept a close watch on chess playing computers, while Slate, Atkin and Gorlen (who later left the project) began to develop their mechanical chess player.

By 1975, Levy reported that he felt the two strongest programs were the Northwestern program and Kaissa, a Russian program. Levy's wager had been increased to one thousand two hundred and fifty pounds (only worth $2,500 because of the falling value of the English pound) with the addition of three other scientists betting against Levy.

Then in 1977, the Atkin/Slate program named Chess 4.5 won the Minnesota Open against human opponents. Levy played its successor, Chess 4.6, in the first formal challenge for the wager and won. At the end of that year, Levy played Kaissa and won.

As the deadline of August 1978 approached, arrangements were made for the final match between the Northwestern program and Levy to be played at the Canadian National exhibition in Toronto. Slate had already begun writing Chess 5.0, which would be a complete rewrite of the program. However, Levy played Chess 4.7 because Chess 5.0 was incomplete by the deadline.

Before leaving for Toronto, Levy received a challenge from Richard Greenblatt of M.I.T. to play M.I.T.'s MacHack. A two game match was agreed upon. Levy won both games.

In Toronto, a six game match was agreed upon. This meant Chess 4.7 needed 3½ (win 1, draw ½, loss 0) out of 6 points to win the match. Five of the six scheduled games were played. The result was Chess 4.7-1½, Levy-3½, confirming the pre-match doubts of Slate and Atkin. Figures 1 through 5 list the moves of the 5 games and board layouts at particular stages of the games.

Levy reported that by game four, he led 2½-½, he decided to try outanalyzing Chess 4.7. This accounts for the change in opening style, the sharp tactical game and Levy's only loss.

The following is an interview between **Creative Computing** and David Slate.

**CC:** The machine drew the first game and won the fourth game. How much of that do you think is due to Levy's knowledge of computers?

**DS:** Well, he knows something about the machine, and he did take advantage of the machine's weaknesses. Perhaps he did it somewhat better than another player of that rank. Actually, the machine's performance in that match was 2160 level, which is higher than its rating. I don't know what its current published rating is, but it's right around 2030. (Both ratings are expert.) That is an established rating, based on thirty-one games. So its playing strength is somewhat higher in this match than it usually is. It's not necessarily the case that Levy did so well. Rather, in the games that he won, he took advantage of what he knew were certain weaknesses of the computer - certain strategic weaknesses.

**CC:** Such as?

**DS:** When the computer is on the white side of the Sicilian Defense, he should normally get his knight on Queen four. Well, he (chess 4.7) makes the mistake of trading his knight for black's knight on Queen bishop six, which allows black to centralize (See Fig. 2) his pawns. That's something we first noticed when we played a match game with Levy on 4.5, a year and a half ago. I

**He knows something about the machine, and he did take advantage of the machine's weaknesses.**

analyzed it and there were a number of reasons it liked to trade the knights and it wasn't so easy to prevent it. So with 4.6, there was only a small change. I was not able to make that much of a change.

**CC:** So he knew about the weakness before hand?

**DS:** Yes he did, and he succeeded in exploiting it, in at least two games.

**CC:** I thought that your opening theory was kept in libraries and played by rote.

**DS:** Yes, it does, but you see there are many different ways you can reach

Game 1 **Reverse Pirc** Levy - CHESS 4.7

| | | | |
|---|---|---|---|
| 1. | P-KN3, P-Q4 | 35. | R-Q8, P-KR3 |
| 2. | B-N2, P-K4 | 36. | RxP, RxP |
| 3. | P-Q3, N-KB3 | 37. | R-Q8, R-KB6 |
| 4. | N-KB3, N-B3 | 38. | R-R8, P-KN4 |
| 5. | O-O, B-Q2 | 39. | P-Q5, P-KR4 |
| 6. | P-N3, B-QB4 | 40. | P-Q6, K-N2 |
| 7. | B-N2, Q-K2 | 41. | RxP, R-B2 |
| 8. | P-QR3, P-K5 | 42. | R-R5, K-B3 |
| 9. | N-K1, O-O | 43. | B-B3+, K-N3 |
| 10. | P-Q4, B-Q3 | 44. | R-K5, R-B6 |
| 11. | P-K3, N-KN5 | | |
| 12. | P-R3, (See fig. 1) NxP(6) | | |
| 13. | PxN, Q-N4 | | |
| 14. | P-KN4, QxP+ | 45. | B-N4, R-B5 |
| 15. | R-B2, B-N6 | 46. | R-K7, R-B2 |
| 16. | Q-K2, QxR+ | 47. | RxP(4), R-Q2 |
| 17. | QxQ, BxQ+ | 48. | R-K7, P-R5 |
| 18. | KxB, P-B4 | 49. | K-N2, P-N5 |
| 19. | PxP, N-K2 | 50. | K-R2, P-N3 |
| 20. | P-B4, RxP+ | 51. | K-N2, R-Q1 |
| 21. | K-N1, P-B3 | 52. | P-R4, N-Q2 |
| 22. | N-QB3, R-R4 | 53. | P-R5, N-B3 |
| 23. | K-R2, R-KB1 | 54. | PxP, N-Q4 |
| 24. | N-Q1, N-N3 | 55. | P-N7, NxR |
| 25. | R-B1, BxP | 56. | PxN, R-KR1 |
| 26. | BxB, R-B8 | 57. | B-Q6, K-B3 |
| 27. | N-N2, R-B6 | 58. | P-N8=Q, RxQ |
| 28. | PxP, R(4)xB+ | 59. | BxR, KxP |
| 29. | K-N1, PxP | 60. | B-B4, K-B3 |
| 30. | R-B8+, N-B1 | 61. | B-Q2, K-N3 |
| 31. | B-B3, R-Q6 | 62. | B-K1, K-N4 |
| 32. | N(1)-K3, R(R)xN | 63. | B-B2, K-R4 |
| 33. | NxR, RxN | 64. | B-K1 |
| 34. | B-N4, R-KB6 | | Drawn |

Figure 1

those sorts of positions. He would kick the machine out of the book with pawn to rook three, or something. You can't cover everything. It has to be done more generally. We managed. During the last games, I changed the openings to get out of that and we did partially succeed. The machine still lost, but it was a decidedly different kind of game.

**CC:** How much does it cost for an average tournament game in computer time?

**At commercial rates, each game would cost fifty thousand dollars, at least. But non-commercial, they do quote some in-house figure, which is not nearly that much, a few hundred dollars.**

**DS:** Well, research and development is done on Northwestern's 660, but for tournament and matches, we tend to be on a CDC 176, because of its speed. An average tournament game, since the machine thinks on the opponent's time, essentially we're dedicating the machine to it. So if the game goes in real-time four hours, which is quite possible, it gets expensive. But we don't pay commercial rates. We're not on a production machine. We use machines in the Control Data plant that are either their in-house test machines or ones that they're testing either to ship out to a customer. So they're somewhat experimental. Sometimes that hurts us because sometimes they aren't quite reliable yet. They're still getting the bugs shaken out of them. We had some problems in the Levy match, the machine failed more than once. It failed in three of the five games. And in the last game it failed a few times. We've had some better luck. Some other tournaments, the machine has run flawlessly for five straight games. We can't predict how many times it will fail. At commercial rates, each game would cost fifty thousand dollars, at least. But non-commercial, they do quote some in-house figure, which is not nearly that much, a few hundred dollars.

**CC:** What about Chess 5.0?

**DS:** I'm working on the new chess program, Chess 5.0, now. Its a complete revision, but it shares many of the features of Chess 4.7, but it is a complete revision, in the same way Chess 4.0 changed from Chess 3.0. Chess 4.7 is written in assembly language, while Chess 5.0 is written in Fortran, a special dialect of Fortran. There's always a battle between having transportability, elegance and the features of a higher level language in computing which lets you express things simply and elegantly, which if you want to express a lot of chess ideas, you need some concise way to do that. On the other hand, higher level languages have the drawback that, unless they are very cleverly written, the programs are much less efficient than assembly language. They run much slower to do the same things. Therefore, we have a trade off. Now I'm trying to write a particular dialect of Fortran which gets the best of both worlds. It's very

Game 2 **Sicilian Defense** CHESS 4.7 - Levy

| | | | |
|---|---|---|---|
| 1. | N-QB3, P-QB | 21. | P-QN3, BxB |
| 2. | P-K4, N-QB3 | 22. | KxB, R(N)-B1 |
| 3. | P-B4, P-QR3 | 23. | Q-R4, Q-B7+ |
| 4. | N-B3, P-KN3 | 24. | K-Q3, QxP(N) |
| 5. | P-Q4, PxP | 25. | Q-Q4, Q-B6+ |
| 6. | NxP, B-N2 | 26. | K-B2, Q-K7+ |
| 7. | B-K3, P-Q3 | 27. | K-B1, P-K4 |
| 8. | NxN (See Fig. 2), PxN | | |
| 9. | B-K2, R-N1 | 28. | PxP, PxP |
| 10. | Q-B1, Q-R4 | 29. | QxP, R(KB)-K1 |
| 11. | B-Q2, Q-N3 | 30. | Q-N3, RxP(5) |
| 12. | N-R4, Q-R2 | 31. | Q-R3, R-Q1 |
| 13. | N-B3, B-Q5 | 32. | Q-B1, Q-Q7+ |
| 14. | N-Q1, N-B3 | 33. | K-N1, R-K7 |
| 15. | P-B3, B-N3 | 34. | QxR, QxQ |
| 16. | Q-B2, N-N5 | 35. | R-K1, QxR+ |
| 17. | Q-R4, O-O | 36. | K-N2, R-Q7+ |
| 18. | BxN, BxB | 37. | K-R3, QxR |
| 19. | QxP(B), BxN | | White resigns 17 moves later |
| 20. | KxB, B-K6 | | |

Figure 2

## Wager, con't....

efficient, but at the same time it gives you a higher level language.

**CC:** During your match with Levy, the computer used an electronic chess board that will later be attached to a robot arm. Have you finished work on the arm?

**DS:** No, we're still working on it. The arm will be a very interesting addition. It will pick the piece up, slap the chess clock and shake your hand when the game is over.

**Game 3 English Opening** Levy - CHESS 4.7

1. P-QB4, N-KB3
2. P-QR3, N-B3
3. N-QB3, P-Q4
4. PxP, NxP
5. P-Q3, NxN
6. PxN, P-K4
7. P-N3, B-K2
8. B-KN2, Q-Q3
9. N-B3, B-K3
10. O-O, O-O
11. Q-R4, Q-B4
12. B-Q2, P-QN4
13. Q-B2, P-B3
14. R(B)-N1, R(R)-Q1
15. Q-N2, R(Q)-N1
16. B-K3, Q-Q3
17. N-Q2, B-Q4 (See Fig. 3)
18. BxB +, QxB
19. Q-N3, QxQ
20. NXQ, P-B4
21. B-B5, B-Q3
22. R-N2, K-R1
23. R(1)-N1, P-QR3
24. BxB, PxB
25. N-Q2, P-B5
26. K-N2, PxP
27. P(R)xP, R(N)-Q1
28. P-R4, N-R2
29. N-K4, PxP
30. R-N6, P-Q4
31. N-B5, N-N4
32. NxP(4), R-R1
33. P-QB4, PxP
34. PxP, N-Q5
35. P-K3, N-B6
36. P-B5, N-N4
37. P-B6, N-K5
38. P-B7, RxP +
39. K-N1, R(7)-B1
40. R-N8, P-KR4
41. RxR(R), RxR
42. R-N8 +, resigns

Figure 3

Like the title of Woody Allen's movie, David Levy should have been satisfied with his success and "Taken the money and run." Instead, Levy has announced that he will have a new wager with the total bet up to $10,000 in units of $1,000 with personal acquaintances. The deadline for this new wager is January 1, 1984.

In agreement with Ken Thompson, a programmer for BELLE at Bell Telephone Labs in New Jersey, Levy reported that he felt there was a barrier at the 2200 mark (the division between expert and master). Levy added that he felt the 50,000 fold increase in computing speed might be possible within the decade, which would give the ratings of the strongest programs a jump in ratings up to 2300 or above.

**Levy feels that an advancement in hardware is possible to increase the strength of chess playing computers. He doesn't seem to feel there will be a breakthrough in the software aspects of chess computers.**

However, Levy also noted that concept formation in Artificial Intelligence (AI) is one area where little or no progress has been made. So although a computer can calculate moves as fast or faster than a human chess master, it will not understand the positional ideas (like a weaken king side, stopping a flank attack, etc.) which are crucial to the game.

In the terms of a human chess player, Mr. Levy appears to have "hung his face."

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While Levy is looking at the history of, or lack of, concept formation in AI, it's puzzling why he feels this trend will continue. The problems of developing a chess playing computer has immediate appeal to a wide number of programmers and the entire computer field. This number is growing. It appears that Levy is not the only person who has realized this lack of concepts in programming and with the increase in people attacking this area, the chances for a breakthrough in software becomes better as the years go on.

**Game 4 Latvian Gambit** CHESS 4.7 - Levy

1. P-K4, P-K4
2. N-KB3, P-KB4
3. PxP, P-K5
4. N-K5, N-KB3
5. N-N4, P-Q4
6. NxN +, QxN
7. Q-R5 +, Q-B2
8. QxQ +, KxQ
9. N-B3, P-B3
10. P-Q3, PxP
11. BxP, N-Q2
12. B-KB4, N-B4
13. P-KN4, NxB +
14. PxN, B-B4
15. O-O, P-KR4
16. N-R4, B-Q5
17. B-K3, B-K4
18. P-Q4, B-Q3
19. P-KR3, P-QN3
20. R(B)-K1, B-Q2
21. N-B3, PxP
22. PxP, R-R5
23. P-B3, R(1)-R1
24. K-B1, B-N6
25. R-K2, B-B1
26. K-N2, B-Q3
27. B-N1, R-R6
28. R(1)-K1, R-N6 +
29. K-B2, R(1)-R6
30. R-K3, B-R3
31. N-K2, BxN
32. R(1)xB, P-B4
33. P-B4, RxR
34. RxR, R-R5
35. K-N3, R-R8
36. B-B2, R-Q8
37. R-R3, PxP
38. RxP +, K-B1
39. R-Q7, R-Q6 +
40. K-N2, B-B4
41. RxP(5), R-Q7
42. P-N4, BxP
43. R-Q8 +, K-B2
44. R-Q7 +, K-B1
45. RxP(4), R-N7
46. K-B3, B-B4
47. R-Q8 +, K-K2
48. B-R4 +, K-B2
49. P-N5, P-N3
50. R-Q7 +, K-B1
51. PxP, RxP
52. P-B5, R-R6 +
53. K-N4, R-R5 +
54. K-R5, R-Q5
55. R-QB7, B-K2 (See Fig. 4) Black resigns

Figure 4

So when the deadline for Levy's new wager arrives, we can be sure of several things.

A. The programs he will be playing will be stronger.

B. Mr. Levy will be a few years older.

The fact that Levy will be older may or may not have some bearing on the wager. There has been shown a direct correlation between age and

playing strength among top players. A weaker playing skill seems to come with increased age. Still, this rule cannot be applied to a specific

**Game 5 English Opening** Levy - CHESS 4.7

1. P-QB4, N-KB3
2. P-QR3, P-B3
3. P-Q3, P-Q4
4. Q-B2, PxP
5. QxP, P-K4
6. N-KB3, B-Q3
7. P-KN3, B-K3
8. Q-B2, N(1)-Q2
9. B-N2, O-O
10. O-O, Q-N3
11. N(1)-Q2, Q-B4
12. Q-N1, P-KR3
13. P-QN4, Q-N4
14. Q-B2, N-N3
15. B-N2, P-QR4
16. P-QR4, Q-R3
17. PxP, QxP(4)
18. B-B3, Q-B4
19. R(B)-B1, N(N)-Q2
20. P-R5, Q-R2
21. Q-N2, N-N5
22. N-K4, B-B2
23. P-R3, P-KB4 (See Fig. 5)
24. PxN, PxN
25. PxP, BxP(5)
26. B-K1, N-B4
27. R(B)-N1, R(R)-K1
28. B-Q2, R-B2
29. B-K3, B-Q3
30. Q-B2, BxN
31. BxB, R-R1
32. R-QB1, P-QN3
33. K-N2, Q-N2
34. PxP, RxR
35. RxR, N-K3
36. R-R7, Q-B1
37. Q-R2, R-B3
38. R-R8, B-N1
39. B-N4, K-B2
40. Q-R7 +, BxQ
41. RxQ, BxP
42. BxN +, RxB
43. BxB, resigns

Figure 5

individual and Levy is still a young man.

In concluding this article, it should be noted that **"64"** (a Russian chess publication) related a conversation between former world champion Robert Fischer and Alfreddo Sheppeldt, during Fischer's stopover visit in West Berlin.

Fischer became attracted to a chess computer at a used bookstore he was visiting. The article did not state if he played it or not. In conversation with Alfreddo Sheppeldt, he held the belief that chess computers have a great future. □

**World Checker Champion, Dr. Marion F. Tinseley has a $5,000 wager that he will beat any computer within a five year period. For further information contact the American Checker Federation, 3475 Belmont Ave., Baton Rouge, LA 70808.**

**If you want your chess playing program to play in a United States Chess Federation rated tournament, your program must be evaluated by the USCF Rating Committee. Request "Procedures for Computer Chess Program Registration" from the United States Chess Federation, 186 Route 9W, New Windsor, NY 12550. Membership for chess playing programs cannot be bought at tournament sites.**