REVIEW

BEHIND DEEP BLUE
BUILDING THE COMPUTER THAT DEFEATED THE WORLD CHESS CHAMPION

by Feng-hsiung Hsu

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Reviewed by Dap Hartmann

> "Over half a year of my life was wasted
> fixing problems related to en-passant
> in one chess machine after another."
> — Feng-hsiung Hsu

This is the book we have all been waiting for. According to the blurb on the dust jacket, it is 'a page turner!' and 'a great story!'. Feng-hsiung Hsu, the principal designer of the Deep Blue chess machine, 'reveals the inside story of what happened behind the scenes at the two historic Deep Blue vs. Kasparov matches'. It certainly is a fast paced book and a joy to read, but it does not entirely satisfy the informed computer-chess enthusiast. There is disappointingly little detail on the (algorithmic) secrets in Deep Blue, and I wonder whether Hsu really reveals everything that happened behind the scenes. In the aftermath of the New York match, I heard several stories for which the present book offers neither confirmation nor refutation.

In the Preface, Hsu says that he wants to tell his story like James Watson in *The Double Helix*, and also that he is greatly influenced by the style of Richard Feynman's *Surely You're Joking, Mr. Feynman*. Both are wonderful books indeed, yet a more appropriate exemplar comes to mind: Jonathan Schaeffer's *One Jump Ahead*, a great story written in a wonderfully uncomplicated style. Although that book is listed in Appendix C ('Further Reading'), Hsu does not really relate to it.

The maturing of computer chess has occurred at an incredible pace. In 1984, IM David Levy still easily beat (4-0) Cray Blitz – then the world's strongest chess program. About a year later, Feng-hsiung Hsu changed the topic of his thesis subject, from creating a new laser printer standard for oriental languages, to computer-chess chip design. Another 12 years later, Deep Blue beat world champion Gary Kasparov in a six-game match (3½-2½). The story in between is the subject of this book.

The greatest controversy during the New York match, was over Deep Blue's move 37. Be4 in game two. While Kasparov claimed that only a few of the top grandmasters could have played this move, Hsu did not regard it very spectacular: "I remember that I was saying to myself at this point in the game, 'perhaps Be4 blocking the e-file pawn would have been a good move somewhere around here'". After the game, Kasparov demanded to see the computer log file. It is not clear what he hoped to find, because there really *is* nothing to find. Like most computer-chess programs, Deep Blue keeps a log file of its ponderings during the course of a game. The logs from the New York match are still available at www.chess.ibm.com, and so I had a close look at the log file for game two. After playing 36. a×b5, Deep Blue naturally expects Kasparov to recapture the Pawn. The log file reads:

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hash guess Pa6b5p,Guessing axb5 (mpicom.c:692) Waiting for worker(s)=3fe Ebook:
root.fulleval(0)=-29 softinc=3 Done Done. Starting at iteration=8()
assert_search_mode_interrupts: should be enabled interrupts 8(4)(mess stat: t=0)
ascention=3645156 Lg1/0 Exh5 JLn=0 ovl=0 jobs=1 CkC=168487 CkAck=8174143
[Qb6](30)[Qb6](30) 30^ T=1 4/8/9 ni5.32M i7.69M ww0.00M a3.03M s8.87T u7.08T
qf2b6 @t.Ra8a2r @s.ra1a2R @+.Bd6c7 @$.qb6e6 @.Kg8h8+ @.bc2e4 s.Rc8b8 t.ra2a6
.Qe8d8 .pd5d6 .Bc7b6 [FH: no exit] 8(6) [Qb6](53) 53 T=4 4/9/10 ni5.27M i6.
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Ignoring ten sequences of 28 concatenations of (o0), (o1), or (o2), and ignoring the 148 hash (#) symbols (probably a time indicator), the text above represents one quarter of the entire log file entry for move 37. What on earth could Kasparov have learned from this near gibberish? Just about the only useful information is that it took Deep Blue two minutes and 32 seconds to play this move. If the team had cheated, it had to do so awfully

fast. Nevertheless, Hsu writes that "DEEP BLUE's game logs contained its 'inner thoughts' on how the games would proceed […] If he [Kasparov] had the logs, he would have a complete road map on how DEEP BLUE would behave […] in various circumstances." I am sorry, but that is totally absurd. Either the game logs at the IBM website are expurgated versions (even though this one is called 'Game log: full'), or I am a complete moron. Hsu's statement that "Even a rank beginner, armed with the game logs, a very good memory, and the help of a good team of Grandmasters, would be able to beat DEEP BLUE consistently by merely memorizing the winning lines", is way beyond belief. To be honest, it is ridiculous. And even if the log files contained valuable information, it would hardly make a difference. The DEEP BLUE software was modified (bug fixes) after every game, and there are many unpredictable effects in a 50+ processor system computing 200 million nodes per second. Still, Hsu claims that "Granting him [Kasparov] access to DEEP BLUE's game logs would be equivalent to giving him DEEP BLUE's silicon head on a silver platter, with $700,000 on the side." No, it was only psychological warfare to withhold those game logs from Kasparov.

Allegedly, Kasparov knows a fair amount about computer chess, but some anecdotes suggest otherwise. In game 5 of the Philadelphia (1996) match, Kasparov played 1. … e5 in response to DEEP BLUE's 1. e4. That was a surprise, because the Sicilian defense (1. … c5) has always been Kasparov's weapon of choice against the King's Pawn opening. DEEP BLUE answered immediately with 2. Nf3, a move from its opening book outside of the Sicilian. Any human opponent would have spent some time thinking about Kasparov's unusual response, but not DEEP BLUE, of course. Yet, Kasparov wondered "How could you know that I would play this?", revealing his ignorance of how computers play the opening. It seems that Kasparov occasionally listens to the wrong people. In another anecdote (p. 204), a reporter told Kasparov that he had seen a game between two versions of DEEP BLUE Jr., and that he was 'quite impressed by the human-like quality of the moves played by the new program'. It is difficult to believe that this would make Kasparov nervous, as the reporter could not reproduce the game, and did not even know which opening had been played.

Most of the book reads like a suspense novel. The pace is fast, and Hsu conveys to the reader the feeling of tension and time pressure: "Murray, Joe and I were already swamped with the chip work […] to make sure that we would be ready for Gary Kasparov" (p. 148); "We had just enough time to get a new batch of chips for the match" (p.157); "our match date with Gary Kasparov was still on" (p. 159). But just when Chapter 9 ends with a great cliff hanger ("The question was whether we had enough time to create something that could beat Gary Kasparov in February 1996"), Chapter 10 suddenly jumps back in time to 1994, to tell the story of how the idea for the match got started. You have to wait five pages before returning to the suspenseful buildup towards the first match: "About two weeks before the match, the remainder of the chips arrived"; "We had barely enough time […] to test all the hardware"; "We […] did not have as many chess chips as we would have liked". Clearly, it was not easy sailing. Amateur chess programmers will find comfort in learning that even DEEP BLUE played crucial moves which were evaluated as only $^1/_{100}$ of a Pawn better than the next move. Also, no matter how fast your machine, there is always that same excuse: "DEEP BLUE might have played [some wonderful move] if it could have searched one more ply" (p. 223).

Behind DEEP BLUE is an excellent introduction to the world of computer chess. It is probably a bit disappointing to those who seek more information on the inner secrets of DEEP BLUE. Hsu does not provide many details about the smart tricks that he and the other team members built into the machine. He tells us (p. 192): "I found a pruning scheme that I was happy with", but he does not explain what it is. And: "The new evaluation function offered so many powerful new features", yet he does not elaborate on the subject. Two pages later: "Other major new features were also added during the last two months of chip design". Tell us about it; inquisitive minds want to know. More (and annotated) games would have been great, especially all the important games described in the text. For example, CRAY BLITZ – CHIPTEST, ACM 1987, or the game against Igor Ivanov, which Hsu describes as "one of the strangest affairs I have ever seen". The reading audience would like to see that too.

There are a few small mistakes, such as: "The netlist for the new chess chip was sent out in September 1997 […] Fabrication for the new chips started in late December 1996" (p. 194). Quite a stunning achievement. I guess it should read 'September 1996'. A pleasant surprise was the anecdote on p. 173, which I had apparently completely forgotten. At the time, I thought that it was the ultimate proof that a computer can pass the Turing Test in chess. One thing I did not appreciate, is the ax that Hsu has to grind with Hans Berliner. Repeatedly he emphasizes that he was not Dr. Berliner's student, and that Dr. Berliner had no involvement with DEEP THOUGHT. That is all true, but sadly not written in the style of his admired Richard Feynman. Hsu seems proud of his bad-boy reputation (Chapter 2: An Office of Troublemakers), which almost gets him expelled after an

April's fool prank. But when his future at Carnegie Mellon is hanging by a thread because "In my blunt response to Dr. Berliner I had effectively claimed that HITECH was passé, without presenting a reason", the seed of his discontent was sown. It is a blemish on an otherwise positive and enthusiastic account of an exciting twelve years.

Hsu is deservedly proud of his achievement, but he dislikes the 'man versus machine' image that people generally painted. He considered it a 'man versus man' encounter: "In the 1996 match, man won as a performer, and in the 1997 rematch, man won as a toolmaker". I fully agree, and I applaud his sentiment that: "What I really learned from the DEEP BLUE project is a stronger appreciation of the beauty of the art practiced by the Grandmasters". That strikes me as sincere, as does: "DEEP BLUE is not intelligent. It is only a fine-crafted tool that exhibits intelligent behavior in a limited domain."

Incredible as it may seem, after the rematch Hsu actually started to work on yet a more powerful version of the chess chip. Apart from the possibility of another match, Hsu desperately wanted to prove, once and for all, that his machine was really the strongest chess playing entity on the planet. Fortunately, one day, he realized what he was doing, and he told himself: "Get a life. You are free". And so he was, and so he did. He left IBM in 1999 to work as a research scientist for Compaq (now HP).

Will Feng-hsiung Hsu ever return to computer chess? I think that is pretty unlikely. What more is there to prove, after your machine has defeated Gary Kasparov? But not all is lost. In Chapter 13 ('Life after Chess'), Hsu writes: "I used to play Go passionately, but I don't believe I will ever work on it. The game is too hard for a computer at the moment". Dear CB, we can wait until you decide that the time is right!

Beyond DEEP BLUE may not be the computer chess equivalent to *One Jump Ahead*, just like Fauré's requiem is not quite Mozart's requiem. Still, it is a wonderful book which I warmly recommend.

Photo by Frederic Friedel

TWO WORLDS, TWO GIANTS.
Garry Kasparov (l) playing DEEP JUNIOR in New York 2003.
(DEEP JUNIOR is operated by Amir Ban.)