

# Dancing with algorithms

By Malcolm Pein

DEEPMIND, the British artificial intelligence company, has released over 200 games of AlphaZero, the awe-inspiring chess-playing entity that taught itself to play using deep reinforcement learning algorithms.

The results show that AlphaZero is much stronger than conventional chess engines, which are programmed to evaluate positions according to criteria honed by their programmers. In contrast, AlphaZero was given only the basic rules of the game and improved by playing 44 million games against itself in just nine hours and updating its neural networks with the knowledge learned from experience. AlphaZero decisively defeated the best software program, Stockfish. In the games played from the starting position where AlphaZero could select its openings, AlphaZero won +35 = 72 -3. From starting positions used in computer chess competition, the score was AlphaZero +17 = 75 -8.

It is a delight to see how aggressive – swashbuckling, one might even say – AlphaZero's playing style is. AlphaZero seems to value mobility and activity over everything else and pays far less regard to material gain than conventional programs. In that sense, it seems far more human, which I find rather heartening. As Garry Kasparov commented: "Because AlphaZero programs itself, I would say that its style reflects the truth."

Back in June, DeepMind co-founder Demis Hassabis, himself a former chess prodigy, allowed Dominic Lawson, Chris Flowers and myself to play AlphaZero as long as the games were kept under wraps until the recently published peer-reviewed scientific paper on AlphaZero appeared in *Science*. GM David Howell joined as our adviser.

We played two games and were incredibly lucky to draw the first. AlphaZero played the Berlin Defence – we went for the dull symmetrical variation and the first 17 moves followed a game of David's against Dmitry Andreikin that we had been analysing previously. In the return we were not so lucky:

AlphaZero –

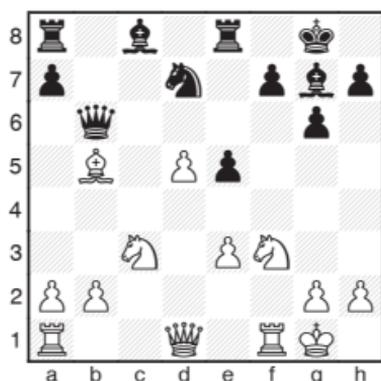
Pein, Lawson, Flowers, Howell

King's Indian

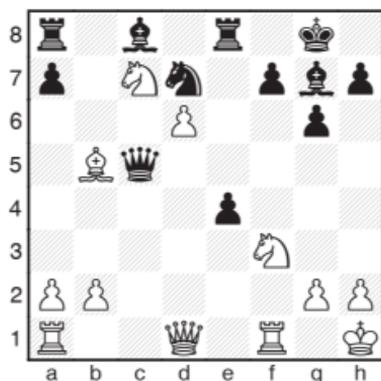
1.d4 Nf6 2.c4 g6 3.Nc3 Bg7 4.e4

d6 5.Be2 0-0 6.Be3 c5 7.d5 e6

8.Nf3 exd5 9.cxd5 b5? (I take responsibility for this error. I liked the exchange of knight for AlphaZero's dark bishop and resulting control of dark squares, but AlphaZero shows this is of no value. 9...Bg4 was sounder) 10.e5! (10.Bxb5 Nxe4 11.Nxe4 Qa5+ 12.Qd2 Qxb5 13.Nxd6 Qxb2 is OK) 10...dxe5 11.Bxc5 Re8 12.Bxb5 Nbd7 13.Be3 Ng4 14.0-0! (14.Bg5 Qb6 15.0-0 e4 16.Qe2 Ba6 17.Bxa6 exf3 18.Qxf3 Nxh2! was my intention and if 19.Kxh2 Qxa6. Even this isn't especially good, but seemed like a good idea at the time) 14...Nxe3 15.fxe3 Qb6



16.Kh1!! Qxe3 17.d6 e4 18.Nd5 Qc5 19.Nc7



Rf8?! (We should have gone for Lawson's delightfully insouciant proposal, 19...Bxb2, and ignored the hanging rooks. After all, only one can be taken at a time. 20.Nxe8 Qxb5 21.Nc7 Qc5 22.Ng5!! Qxg5 23.Qb3! is the refutation, although Black has more chances to resist) 20.Rc1 Qh5 21.Nd4 Qxd1 22.Rfxd1 Bxd4 (22...Rb8 23.Nc6 is horrific) 23.Nxa8 Be3 (23...Bxb2! and if 24.Rc2 Ba3, or Be5, or if 24.Rc7 Nf6 was better. Now we are the exchange down for no compensation) 24.Rc3 Bf4 25.Nc7 Be5 26.Rc4 Rd8 27.Rxe4 Bb7 28.Re2 Bf4 29.Bxd7 Rxd7 30.Re7 Rxd6 31.Rxd6 Bxd6 32.Rd7 Bc5 33.Ne6 Bxg2+ 34.Kxg2 fxe6 35.Kf1 e5 36.Ke2 Bd4 37.b4 h5 38.a4 g5 39.Kf1 g4 40.Kg2 h4 and it was time to bend the knee... 1-0