MoHex Wins Hex Tournament

Broderick Arneson, Ryan Hayward, and Philip Henderson

Department of Computing Science, University of Alberta, Canada

There were four entrants in the 2009 Hex competition: Yopt by Abdallah Saffidine and Tristan Cazenave of France; Six (version 0.5.3) by Gábor Melis of Hungary; Wolve by Broderick Arneson, Ryan Hayward, and Philip Henderson of Canada; and MoHex by Philip Henderson, Broderick Arneson, and Ryan Hayward. The same four programs competed in the 2008 Olympiad. A fifth program, Bit2, registered but withdrew before the competition.

Yopt is a UCT Monte Carlo program that uses the RAVE formula, some dead cell analysis, and 80K rollouts (with the bridge and 432 patterns) per move. In a pre-competition trial against Six, Yopt won 99 of 200 games. A non-Olympiad version of Yopt computes virtual connection information in the UCT tree (Cazenave and Saffidine, 2009).

Six, the 2003-2006 gold medallist and 2008 bronze medallist, uses a 2-ply truncated-width alpha-beta search, a Shannon style electric circuit evaluation function (with cell adjacencies augmented by virtual connections), and some pruning of low degree dead cells.

Wolve, the 2008 gold medallist and successor to the 2006 and 2003 silver medallist Wolve and Mongoose programs, is similar to Six, but with more dead cell analysis and virtual connection computation. Recent improvements include changing the 1-2ply iterative deepening to 1-2-4ply as time permits. On average, one 4ply move takes just over one minute; the variance is large. To save time, Wolve caches previously computed opening moves.

MoHex is a UCT Monte Carlo program built on the code base of Fuego, the Go program developed by Martin Müller, Markus Enzenberger, and others at the University of Alberta. Recent improvements include performing virtual connection computation and inferior cell analysis in the UCT tree, and using lock-free parallelization (Enzenberger and Müller, 2009). MoHex and Wolve share many features, including an endgame solver which uses one thread and runs in parallel with the rest of the program.

Each player opened once against each opponent. The tournament completed on Tuesday May 12. Gábor Melis did not attend the tournament; Six’s opening moves were picked by Yngvi Björnsson and Jakub Pawlewicz. Yopt, Six, Wolve, and MoHex used 1, 1, 3, and 8 threads respectively.

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Game 1 Wolve-MoHex 0-1. MoHex’s evaluation scores suggest this to have been a close game, although post-game analysis shows that MoHex is winning (in a known winning position) by 34.W[f11].

Game 2 MoHex-Wolve 1-0. By 17.W[e4] MoHex likes its position. Solver finds MoHex’s winning move 41.W[e2], and from that move onwards generates each move for each player. 46.B[b4] looks ineffective, and might be weak against an opponent that has not yet solved the game.

Game 3 Wolve-Six 0-1. Wolve’s situation seems to deteriorate after 17.B[d7]. Six’s 24.W[g2] looks brilliant. Six is winning by 28.W[e3].

1email: hayward@cs.ualberta.ca
2See previous games competition reports (Melis and Hayward, 2003; Willemsen and Björnsson, 2004; Hayward, 2006; Arneson, Hayward, and Henderson, 2008).

Game 5 MoHex-Six 1-0. MoHex thinks 14.W[h2] is weak, as its evaluation score (playout win fraction) jumps to 0.75 after 15.B[i5]. MoHex is winning by 19.B[h5]


Game 7 Six-Yopt 0-1. This game seems very close until near the end. Yopt is winning by 42.B[i5].

Game 8 Yopt-Six 0-1. This is another close game, this time with Six pulling ahead. Six is winning by 48.B[b9]. 56.B[e6] is an elegant move found by Six’s virtual connection engine.

Game 9 Yopt-Wolve 0-1. Post-match analysis shows Wolve is winning by 24.W[f8]. Wolve knows this by 28.W[b7], and so plays seemingly unusual moves from here on. Yopt has no endgame solver and does not see the win; during this endgame its evaluation score climbs over 0.9 before eventually decreasing.

Game 10 Wolve-Yopt 1-0. During the game, Solver finds the winning 25.B[b10] for Wolve. The moves up to this point seem human-like. This result ensures gold for MoHex.

Game 11 Yopt-MoHex 0-1. The white line of bridges may look strong, but Yopt is winning in moves 27 through 30 before blundering with 31.B[d4]; B[c4] would win here. This result ensures silver for Wolve.

Game 12 MoHex-Yopt 1-0. This game seems very close until near the end. A long post-match analysis shows that Yopt reaches a winning position before blundering with 36.B[e2]; B[b3] would win here. MoHex is winning from 37.W[e1] on. This result ensures bronze for Six.

Conclusions. The level of play seems stronger than in previous Olympiads, with a higher proportion of very close games. Reflecting the result of this competition, a post-competition tournament of two hundred games between MoHex and Wolve shows MoHex significantly stronger. It is tempting to conjecture that Monte Carlo will become the algorithm of choice for Hex programs.

Acknowledgements. The success of Wolve and MoHex is due to the support of many people. We thank NSERC, iCORE, Martin Müller, Jonathan Schaeffer, and the UofA GAMES group for financial support; Lorna Stewart and Joe Culberson for loaning computers; Martin Müller and Markus Enzenberger for sharing the Fuego code base; Paul Lu for frequent technical advice; and Yngvi Björnsson, Andrea Buchnik, Laurie Charpentier, Teri Drummond, Leah Hackman, Mike Johanson, Morgan Kan, Maryia Kazkevich, Martha Lednicky, Nathan Po, Jack van Rijswijck, and Geoff Ryan for work on previous versions of Wolve, Mongoose, and our Hex solver.

1. REFERENCES


