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[Peregrine Falcon](#) caught [Pigeon](#) at [Manchester Cathedral](#) ^[5]

Falcon,

a strong private chess engine ^[1] by [Omid David](#) and successor of Omid's earlier program [Genesis](#). Falcon participated at three [World Computer Chess Championships](#), the [WCCC 2003](#) in [Graz](#), the [WCCC 2004](#) in [Ramat Gan](#), and the [WCCC 2008](#) in [Beijing](#) ^[2], as well the [CCT6](#) on-line tournament. Book authors were [Eros Riccio](#) in 2004, and [Erdogan Günes](#) in 2008.

Falcon applies [NegaScout/PVS](#) with [null move pruning](#), [internal iterative deepening](#), [dynamic move ordering](#) by [history](#) and [killer heuristic](#), [multi-cut pruning](#), [selective extensions](#), [transposition table](#), and [futility pruning](#) near [leaf nodes](#) ^[3], and [blockade detection](#) in [endgames](#) ^[4].

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Genetic Algorithm

Omid David has combined his secret efforts with scientific publications, since Falcon was test-bed and object in research of [verified null-move pruning](#) ^[6], [extended null-move reductions](#) ^[7], and [Genetic Algorithms](#) in [evaluation](#) ^[8] ^[9] and [search tuning](#) ^[10], the latter on optimizing 18 search control parameters packed into a 70-bit [chromosome](#). The [fitness function](#) is the total [node](#) count up to the solutions found, from the 879 most [tactical](#) positions of the [Encyclopedia of Chess Middlegames](#) ^[11], as already used by [Yngvi Björnsson](#) and [Tony Marsland](#) in *Learning Control of Search Extensions* ^[12], the lower the fitter. A [one-point crossover](#) uses the chromosomes of two [parents](#), [selected](#) based on fitness criterion ^[13], and creates two [offspring](#). The [mutation](#) operator randomly flips some bits with low probability.

Falcon Breeding

Falcon's GA procedure as pseudo code ^[14]:

1. initialization: randomly generate n 70-bit chromosomes
2. evaluate fitness of each chromosome of a population
3. if (N generations is reached OR fitness value > threshold) terminate
 - repeat until n offspring are generated
 - a. select pair of parents from current population based on fitness criterion
 - b. with probability p, apply crossover to generate two offspring
 - c. mutate the two offspring by randomly flipping some bits
4. replace the old population with the newly generated population
5. goto 2

Learning Result

With a population size of 10, a crossover rate of 0.75, mutation rate of 0.05, and 50 generations, following search parameters were [learned](#) after 35 hours, as noted, not necessarily the best parameter set for every chess program ^[15]:

Parameter	Value range	Bits	Learned	Unit
Null-move use		0-1	11	Boolean
Null Move R		0-7	34	plies
Null Move adaptivity		0-1	11	Boolean
Null Move adaptivity depth ^[16]		0-7	36	plies
Futility depth		0-3	23	plies
Futility threshold depth-1		0-1023	10106	centipawns
Futility threshold depth-2		0-1023	10219	centipawns
Futility threshold depth-3		0-1023	10512	centipawns
Mult-cut use		0-1	11	Boolean
Mult-cut R		0-7	34	plies
Mult-cut depth ^[17]		0-7	36	plies
Mult-cut M		0-31	514	number of moves
Mult-cut C		0-7	33	number of moves
Check extension		0-4	32	quarter plies
One-reply extension		0-4	34	quarter plies
Recapture extension		0-4	32	quarter plies
Passed pawn extension , 7th		0-4	33	quarter plies

[Mate thread extension](#)

0-4

31

quarter plies

70bit

Selected Games

[WCCC 2004](#) round 11, [Falcon](#) - [Shredder](#) ^[18]

```
[Event "WCCC 2004"]
[Site "Ramat Gan, Israel"]
[Date "2004.07.12"]
[Round "11"]
[White "Falcon"]
[Black "Shredder"]
[Result "1/2-1/2"]
```

```
1. e4 c5 2. Nf3 d6 3. d4 cxd4 4. Nxd4 Nf6 5. Nc3 a6 6. Be3 e6 7. f3 b5
8. g4 h6 9. Qd2 Nbd7 10. O-O-O Bb7 11. h4 d5 12. Bh3 b4 13. Na4 dxe4
14. g5 hxg5 15. hxg5 exf3 16. g6 Rxh3 17. Rxh3 Qa5 18. b3 Ne5 19. gxf7
+
Kxf7 20. Bg5 Ne4 21. Qf4+ Kg8 22. Nxe6 Ng6 23. Rh8+ Nxh8 24. Rd7 Nf6
25. Bxf6 Ng6 26. Qd4 Qf5 27. Nxf8 Qxf6 28. Qxf6 gxf6 29. Nh7 Ne5
30. Nxf6+ Kf8 31. Nh7+ Kg8 32. Nf6+ Kf8 33. Nh7+ Kg8 34. Nf6+ 1/2-1/2
```

See also

- [Bird](#)
- [Genesis](#)

Publications

- [Omid David](#), [Nathan S. Netanyahu](#) (2002). *Verified null-move pruning*. [ICGA Journal](#), Vol. 25, No. 3
- [Omid David](#), [Ariel Felner](#), [Nathan S. Netanyahu](#) (2004). *Blockage Detection in Pawn Endgames*. [ICGA Journal](#), Vol. 27, No. 3
- [Omid David](#), [Nathan S. Netanyahu](#) (2008). [Extended Null-Move Reductions](#). [CG 2008](#), pdf
- [Omid David](#), [Moshe Koppel](#), [Nathan S. Netanyahu](#) (2008). *Genetic Algorithms for Mentor-Assisted Evaluation Function Optimization*. [GECCO '08](#)
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- [Omid David](#), [Jaap van den Herik](#), [Moshe Koppel](#), [Nathan S. Netanyahu](#) (2009). *Simulating Human Grandmasters: Evolution and Coevolution of Evaluation Functions*. [GECCO '09](#)
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- [Omid David](#), [Moshe Koppel](#), [Nathan S. Netanyahu](#) (2010). *Genetic Algorithms for Automatic Search Tuning*. [ICGA Journal](#), Vol. 33, No. 2
- [Omid David](#), [Jaap van den Herik](#), [Moshe Koppel](#), [Nathan S. Netanyahu](#) (2014). *Genetic Algorithms for Evolving Computer Chess Programs*. [IEEE Transactions on Evolutionary Computation](#), pdf ^[19]_[20]

Forum Posts

- [Objective proposal Falcon - Crafty](#) by [Vincent Diepeveen](#), [CCC](#), April 29, 2004
- [Diep and Falcon #2 and 3](#) by Chessfun, [CCC](#), April 30, 2004
- [Re: Are you planning to make an SMP version of Falcon?](#) by [Omid David](#), [CCC](#), July 13, 2004
- [Falcon by Omid David Tabibi](#) by [Norbert Raimund Leisner](#), [CCC](#), January 03, 2012

External Links

- [Falcon's ICGA Tournaments](#)
- [The chess games of Falcon](#) from [chessgames.com](#)

Falcon Chess Variant

- [Falcon Chess](#) from [The Chess Variant Pages](#)
- [Falcon Chess](#) by [Harm Geert Muller](#) ^[21]

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- [Peregrine Falcon](#) from Wikipedia
- [Saker Falcon](#) from Wikipedia
- [BBC Nature - Peregrine falcon videos, news and facts](#)
- [Falcons - EcoWeb - Nottingham Trent University](#)

- [BBC News - Rare peregrine falcons raise four chicks in Nottingham](#)
- [News - CMNH Falcon Cam](#)
- [Santa Cruz Predatory Bird Research Group at UCSC - HOME](#)
- [SCPBRG: Peregrine Falcon Web Cam, San Francisco](#)
- [Nick Dunlop Photography](#)

Falconry

- [Falconry from Wikipedia](#)
- [De arte venandi cum avibus](#) by [Frederick II - Wikipedia](#)
- [Falconry Canada](#)
- [Falconry](#) by [David Maritz](#)
- [Falconry - Falkenhorst Schloss Aschbach](#)
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The Maltese Falcon

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[The Maltese Falcon \(1941 film\) from Wikipedia](#)
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Misc

- [Falcón \(disambiguation\) from Wikipedia](#)
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- [Falcon \(programming language\) from Wikipedia](#)
- [Falcon Northwest from Wikipedia](#)
- [Falcon Crest from Wikipedia](#)
- [Falkenberg \(disambiguation\) from Wikipedia](#)
- [Falkenburg \(disambiguation\) from Wikipedia](#)
- [Valkenburg \(disambiguation\) from Wikipedia](#)

References

1. [↑](#) [Private Engine List](#) from [Ron Murawski's Computer-Chess Wiki](#)
2. [↑](#) [Falcon's ICGA Tournaments](#)
3. [↑](#) [Omid David](#), [Moshe Koppel](#), [Nathan S. Netanyahu](#) (2010). *Genetic Algorithms for Automatic Search Tuning*. [ICGA Journal](#), Vol. 33, No. 2
4. [↑](#) [Omid David](#), [Ariel Felner](#), [Nathan S. Netanyahu](#) (2004). *Blockage Detection in Pawn Endgames*. [ICGA Journal](#), Vol. 27, No. 3
5. [↑](#) [Peregrine falcons: in pictures](#) - [Manchester Cathedral](#) proved a happy hunting ground for the

female who caught this [pigeon](#). [photo taken May 23, 2009 (c) [Adrian Dancy](#)]

6. [^ Omid David, Nathan S. Netanyahu \(2002\)](#). *Verified null-move pruning*. [ICGA Journal, Vol. 25, No. 3](#)
7. [^ Omid David, Nathan S. Netanyahu \(2008\)](#). *Extended Null-Move Reductions*. [CG 2008, pdf](#)
8. [^ Omid David, Moshe Koppel, Nathan S. Netanyahu \(2008\)](#). *Genetic Algorithms for Mentor-Assisted Evaluation Function Optimization*. ACM Genetic and Evolutionary Computation Conference ([GECCO '08](#))
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12. [^ Yngvi Björnsson, Tony Marsland \(2002\)](#). *Learning Control of Search Extensions*. Proceedings of the 6th Joint Conference on Information Sciences (JCIS 2002), pp. 446-449. [pdf](#)
13. [^ Genetic algorithms](#)
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15. [^ Omid David, Moshe Koppel, Nathan S. Netanyahu \(2010\)](#). *Genetic Algorithms for Automatic Search Tuning*. [ICGA Journal, Vol. 33, No. 2](#), 5. Experimental Results
16. [^ if \(adaptivity && depth = Mult-cut_depth](#)
17. [^ Ramat-Gan 2004 - Chess - Round 11 - Game 5 \(ICGA Tournaments\)](#)
18. [^ Jaap van den Herik wint Humies Award 2014 - LIACS - Leiden Institute of Advanced Computer Science](#)
19. [^ GECCO 2014](#)
20. [^ Falcon Chess](#) by [Harm Geert Muller](#), [CCC](#), July 17, 2008

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