

Minimax (/Minimax)

```

int min = +oo;
for ( all moves) {
    score = minimax(depth+1,
if (score < min) {
        min = score;
    }
}
return min;
}

```

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Negamax

Usually the **Negamax** algorithm is used for simplicity. This means that the evaluation of a position is equivalent to the negation of the evaluation from the opponent's viewpoint. This is because of the zero-sum property of chess: one side's win is the other side's loss.

See also

Search

- [Alpha-Beta](#)
- [Minimax \(program\)](#)
- [Negamax](#)
- [Search Pathology](#)
- [Theorem-Proving and M & N procedure](#)
- [Theorem-Proving from Five-Year Plan](#)

People

- [John von Neumann](#)
- [Claude Shannon](#)
- [Norbert Wiener](#)

Selected Publications

1920 ...

- [Émile Borel](#) (1921). *La théorie du jeu et les équations intégrales à noyau symétrique*. Comptes Rendus de Académie des Sciences, Vol. 173, pp. 1304-1308, English translation by [Leonard J. Savage](#) (1953). *The Theory of Play and Integral Equations with Skew Symmetric Kernels*.
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1940 ...

- [John von Neumann](#), [Oskar Morgenstern](#) (1944). *Theory of Games and Economic Behavior* . Princeton University Press, Princeton, NJ.
- [Norbert Wiener](#) (1948). *Cybernetics or Control and Communication in the Animal and the Machine* - MIT Press, Cambridge, MA.

1950 ...

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- [Émile Borel](#), [Maurice R. Fréchet](#), [John von Neumann](#) (1953). *Discussion of the Early History of the Theory of Games, with Special Reference to the Minimax Theorem*. *Econometrica* , Vol. 21
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1960 ...

- [James R. Slagle](#) (1963). *Game Trees, M & N Minimaxing, and the M & N alpha-beta procedure*. Artificial Intelligence Group Report 3, UCRL-4671, University of California
- [Donald Michie](#) (1966). *Game Playing and Game Learning Automata*. Advances in Programming and Non-Numerical Computation, [Leslie Fox](#) (ed.), pp. 183-200. Oxford, Pergamon. » Includes Appendix: *Rules of SOMAC* by [John Maynard Smith](#), introduces [Expectiminimax tree](#) ^[7]
- [James R. Slagle](#), [Philip Bursky](#) (1968). *Experiments With a Multipurpose, Theorem-Proving Heuristic Program* . *Journal of the ACM*, Vol. 15, No. 1
- [James R. Slagle](#), [John K. Dixon](#) (1969). *Experiments With Some Programs That Search Game Trees*. *Journal of the ACM*, Vol 16, No. 2, [pdf](#)

1970 ...

- [James R. Slagle](#), [John K. Dixon](#) (1970). *Experiments with the M & N Tree-Searching Program* . *Communications of the ACM*, Vol. 13, No. 3, pp. 147-154.
- [Minimax](#) in [Alex Bell](#) (1972). *Games Playing with Computers* .

1980 ...

- [Ivan Bratko](#), [Matjaž Gams](#) (1982). *Error Analysis of the Minimax Principle*. *Advances in Computer Chess 3*
- [Ronald L. Rivest](#) (1987). *Game Tree Searching by Min/Max Approximation*. Artificial Intelligence Vol. 34, 1, [pdf 1995](#)

1990 ...

- [Liwu Li](#), [Tony Marsland](#) (1990). *On Minimax Game Tree Search Pathology and Node-value Dependence*. TR90-24, [University of Alberta](#), [pdf](#)

- [Claude G. Diderich](#) (1993). *A Bibliography on Minimax Trees* . [ACM SIGACT News](#), Vol. 24, No. 4
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- [Thomas Hauk](#), [Michael Buro](#), [Jonathan Schaeffer](#) (2004). *Rediscovering *-Minimax Search* . [CG 2004](#), pdf
- [Mitja Luštrek](#), [Matjaž Gams](#), [Ivan Bratko](#) (2005). *Why Minimax Works: An Alternative Explanation* . [IJCAI 2005](#) » [Search Pathology](#).
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Forum Posts

- [beyond minimax](#) by [Harm Geert Muller](#), [CCC](#), April 27, 2007
- [The evaluation value and value returned by minimax search](#) by [Ma Chao](#), [CCC](#), March 09, 2012 » [Evaluation](#)
- [Why minimax is fundamentally flawed](#) by [Harm Geert Muller](#), [CCC](#), November 09, 2014 » [KRK](#)

External Links

- [Min-Max Search](#) from [Bruce Moreland's Programming Topics](#)
- [Minimax from Wikipedia](#)
- [Minimax estimator from Wikipedia](#)
- [Expectiminimax tree from Wikipedia](#)
- [Maxima and minima from Wikipedia](#)
- [Nash equilibrium from Wikipedia](#)
- [Parthasarathy's theorem from Wikipedia](#)
- [Sion's minimax theorem from Wikipedia](#)
- [Analog voltage maximizer and minimizer circuits](#) from [FreePatentsOnline](#)

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3. [^](#) [John von Neumann](#) (1928). *Zur Theorie der Gesellschaftsspiele* . Berlin
4. [^](#) [Don Beal](#) (1999). *The Nature of MINIMAX Search*. Ph.D. thesis, ISBN 90-62-16-6348, pp. 2, refers [Philip Morrison](#) and Emily Morrison (1961). *Charles Babbage and his Calculating Engines*. Dover Publ. New York
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6. [^](#) [Alexander Reinefeld](#) (2005). *Die Entwicklung der Spielprogrammierung: Von John von Neumann bis zu den hochparallelen Schachmaschinen*. [slides as pdf](#) , Themen der Informatik im historischen Kontext Ringvorlesung an der [HU Berlin](#) , 02.06.2005 (English paper, German title)
7. [^](#) see [Swap-off](#) by [Helmut Richter](#)

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