**AlphaGo**

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Jump to: [navigation](https://en.wikipedia.org/wiki/AlphaGo#mw-head), [search](https://en.wikipedia.org/wiki/AlphaGo#p-search)

[AlphaGo logo](https://en.wikipedia.org/wiki/File:Alphago_logo_Reversed.svg)

AlphaGo logo

**AlphaGo** is a [narrow AI](https://en.wikipedia.org/wiki/Narrow_AI), [computer program](https://en.wikipedia.org/wiki/Computer_program) developed by [Alphabet Inc.](https://en.wikipedia.org/wiki/Alphabet_Inc.)'s [Google DeepMind](https://en.wikipedia.org/wiki/Google_DeepMind) in London to play the [board game](https://en.wikipedia.org/wiki/Board_game) [Go](https://en.wikipedia.org/wiki/Go_(game)).[[1]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-1) In October 2015, it became the first [Computer Go](https://en.wikipedia.org/wiki/Computer_Go) program to beat a human [professional Go player](https://en.wikipedia.org/wiki/Professional_Go_player) without [handicaps](https://en.wikipedia.org/wiki/Go_handicaps) on a full-sized 19×19 board.[[2]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-googlego-2)[[3]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-bbcgo-3) In March 2016, it beat [Lee Sedol](https://en.wikipedia.org/wiki/Lee_Sedol) in [a five-game match](https://en.wikipedia.org/wiki/AlphaGo_versus_Lee_Sedol), the first time a computer Go program has beaten a [9-dan](https://en.wikipedia.org/wiki/Go_ranks_and_ratings) professional without handicaps.[[4]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-leesedolwin-4) Although it lost to Lee Sedol in the fourth game, Lee resigned the final game, giving a final score of 4 games to 1 in favour of AlphaGo. In recognition of beating Lee Sedol, AlphaGo was awarded an honorary 9-dan by the [Korea Baduk Association](https://en.wikipedia.org/wiki/Korea_Baduk_Association). It was chosen by [*Science*](https://en.wikipedia.org/wiki/Science_(journal)) as one of the [Breakthrough of the Year](https://en.wikipedia.org/wiki/Breakthrough_of_the_Year) runners-up on 22 December 2016.[[5]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-5)

AlphaGo's algorithm uses a [Monte Carlo tree search](https://en.wikipedia.org/wiki/Monte_Carlo_tree_search) to find its moves based on knowledge previously "learned" by [machine learning](https://en.wikipedia.org/wiki/Machine_learning), specifically by an [artificial neural network](https://en.wikipedia.org/wiki/Artificial_neural_network) (a [deep learning](https://en.wikipedia.org/wiki/Deep_learning) method) by extensive training, both from human and computer play.

**Contents**

 [hide]

* [1 History and competitions](https://en.wikipedia.org/wiki/AlphaGo#History_and_competitions)
  + [1.1 Match against Fan Hui](https://en.wikipedia.org/wiki/AlphaGo#Match_against_Fan_Hui)
  + [1.2 Match against Lee Sedol](https://en.wikipedia.org/wiki/AlphaGo#Match_against_Lee_Sedol)
  + [1.3 Unofficial online matches in late 2016 to early 2017](https://en.wikipedia.org/wiki/AlphaGo#Unofficial_online_matches_in_late_2016_to_early_2017)
* [2 Hardware](https://en.wikipedia.org/wiki/AlphaGo#Hardware)
* [3 Algorithm](https://en.wikipedia.org/wiki/AlphaGo#Algorithm)
* [4 Style of play](https://en.wikipedia.org/wiki/AlphaGo#Style_of_play)
* [5 Responses to 2016 victory against Lee Sedol](https://en.wikipedia.org/wiki/AlphaGo#Responses_to_2016_victory_against_Lee_Sedol)
  + [5.1 AI community](https://en.wikipedia.org/wiki/AlphaGo#AI_community)
  + [5.2 Go community](https://en.wikipedia.org/wiki/AlphaGo#Go_community)
* [6 Similar systems](https://en.wikipedia.org/wiki/AlphaGo#Similar_systems)
* [7 Example game](https://en.wikipedia.org/wiki/AlphaGo#Example_game)
* [8 See also](https://en.wikipedia.org/wiki/AlphaGo#See_also)
* [9 References](https://en.wikipedia.org/wiki/AlphaGo#References)
* [10 External links](https://en.wikipedia.org/wiki/AlphaGo#External_links)

**History and competitions[[edit](https://en.wikipedia.org/w/index.php?title=AlphaGo&action=edit&section=1" \o "Edit section: History and competitions)]**

Go is considered much more difficult for computers to win than other games such as [chess](https://en.wikipedia.org/wiki/Chess), because its much larger [branching factor](https://en.wikipedia.org/wiki/Branching_factor) makes it prohibitively difficult to use traditional AI methods such as [alpha–beta pruning](https://en.wikipedia.org/wiki/Alpha%E2%80%93beta_pruning), [tree traversal](https://en.wikipedia.org/wiki/Tree_traversal) and [heuristic](https://en.wikipedia.org/wiki/Heuristic) search.[[2]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-googlego-2)[[6]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-6)

Almost two decades after IBM's computer [Deep Blue](https://en.wikipedia.org/wiki/Deep_Blue_(chess_computer)) beat world chess champion [Garry Kasparov](https://en.wikipedia.org/wiki/Garry_Kasparov) in the [1997 match](https://en.wikipedia.org/wiki/Deep_Blue_versus_Garry_Kasparov), the strongest Go programs using [artificial intelligence](https://en.wikipedia.org/wiki/Artificial_intelligence) techniques only reached about [amateur 5-dan](https://en.wikipedia.org/wiki/Go_professional#Pro_and_amateur_dan) level,[[7]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-DeepMindnature2016-7) and still could not beat a professional Go player without [handicaps](https://en.wikipedia.org/wiki/Go_handicaps).[[2]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-googlego-2)[[3]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-bbcgo-3)[[8]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-CNN0128-8) In 2012, the software program [Zen](https://en.wikipedia.org/wiki/Zen_(software)), running on a four PC cluster, beat [Masaki Takemiya](https://en.wikipedia.org/wiki/Masaki_Takemiya) ([9p](https://en.wikipedia.org/wiki/Go_professional)) two times at five and four stones handicap.[[9]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-9) In 2013, [Crazy Stone](https://en.wikipedia.org/wiki/Crazy_Stone_(software)) beat [Yoshio Ishida](https://en.wikipedia.org/wiki/Yoshio_Ishida) (9p) at four-stones handicap.[[10]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-10)

According to AlphaGo's David Silver, the AlphaGo research project was formed around 2014 to test how well a neural network using [deep learning](https://en.wikipedia.org/wiki/Deep_learning) can compete at Go.[[11]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-pcworld_unusual-11) AlphaGo represents a significant improvement over previous Go programs. In 500 games against other available Go programs, including Crazy Stone and Zen,[[12]](https://en.wikipedia.org/wiki/AlphaGo" \l "cite_note-12) AlphaGo running on a single computer won all but one.[[13]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-13) In a similar matchup, AlphaGo running on multiple computers won all 500 games played against other Go programs, and 77% of games played against AlphaGo running on a single computer. The distributed version in October 2015 was using 1,202 [CPUs](https://en.wikipedia.org/wiki/CPU) and 176 [GPUs](https://en.wikipedia.org/wiki/GPU).[[7]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-DeepMindnature2016-7)

**Match against Fan Hui[[edit](https://en.wikipedia.org/w/index.php?title=AlphaGo&action=edit&section=2" \o "Edit section: Match against Fan Hui)]**

In October 2015, the distributed version of AlphaGo defeated the European [Go](https://en.wikipedia.org/wiki/Go_(game)) champion [Fan Hui](https://en.wikipedia.org/wiki/Fan_Hui),[[14]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-MetzWired2016-14) a [2-dan](https://en.wikipedia.org/wiki/Go_ranks_and_ratings) (out of 9 dan possible) professional, five to zero.[[3]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-bbcgo-3)[[15]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-15) This was the first time a computer Go program had beaten a professional human player on a full-sized board without handicap.[[16]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-lemondego-16) The announcement of the news was delayed until 27 January 2016 to coincide with the publication of a paper in the journal [*Nature*](https://en.wikipedia.org/wiki/Nature_(journal))[[7]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-DeepMindnature2016-7) describing the algorithms used.[[3]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-bbcgo-3)

**Match against Lee Sedol[[edit](https://en.wikipedia.org/w/index.php?title=AlphaGo&action=edit&section=3" \o "Edit section: Match against Lee Sedol)]**

*Main article:* [*AlphaGo versus Lee Sedol*](https://en.wikipedia.org/wiki/AlphaGo_versus_Lee_Sedol)

AlphaGo played South Korean professional Go player [Lee Sedol](https://en.wikipedia.org/wiki/Lee_Sedol), ranked 9-dan, one of the best players at Go,[[8]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-CNN0128-8)[[*needs update*](https://en.wikipedia.org/wiki/Wikipedia:Manual_of_Style/Dates_and_numbers#Precise_language)] with five games taking place at the [Four Seasons Hotel](https://en.wikipedia.org/wiki/Four_Seasons_Hotel) in [Seoul](https://en.wikipedia.org/wiki/Seoul), South Korea on 9, 10, 12, 13, and 15 March 2016,[[17]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-17)[[18]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-18) which were video-streamed live.[[19]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-19) Aja Huang, a DeepMind team member and amateur 6-dan Go player, placed stones on the [Go board](https://en.wikipedia.org/wiki/Go_board) for AlphaGo, which ran through Google's cloud computing with its servers located in the United States.[[20]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-JoongAng_Ilbo-20) The match used [Chinese rules](https://en.wikipedia.org/wiki/Rules_of_go#Chinese_rules) with a 7.5-point [komi](https://en.wikipedia.org/wiki/Komidashi), and each side had two hours of thinking time plus three 60-second [byoyomi](https://en.wikipedia.org/wiki/Byoyomi) periods.[[21]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-Korea_Baduk_Association-21) The version of AlphaGo playing against Lee used a similar amount of computing power as was used in the Fan Hui match.[[22]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-22) [The Economist](https://en.wikipedia.org/wiki/The_Economist) reported that it used 1,920 CPUs and 280 GPUs.[[23]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-23)

At the time of play, Lee Sedol had the second-highest number of Go international championship victories in the world.[[24]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-24) While there is no single official method of [ranking in international Go](https://en.wikipedia.org/wiki/Go_ranks_and_ratings#Rating_systems), some sources ranked Lee Sedol as the fourth-best player in the world at the time.[[25]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-goratings.org_2016-25)[[26]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-26) AlphaGo was not specifically trained to face Lee.[[27]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-koreatimes_beatable-27)

The first three games were won by AlphaGo following resignations by Lee Sedol.[[28]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-28)[[29]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-29) However, Lee Sedol beat AlphaGo in the fourth game, winning by resignation at move 180. AlphaGo then continued to achieve a fourth win, winning the fifth game by resignation.[[30]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-30)

The prize was $1 million USD. Since AlphaGo won four out of five and thus the series, the prize will be donated to charities, including [UNICEF](https://en.wikipedia.org/wiki/UNICEF).[[31]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-31) Lee Sedol received $150,000 for participating in all five games and an additional $20,000 for his win.[[21]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-Korea_Baduk_Association-21)

On June 29th, at a presentation held at a University in the Netherlands, Aja Huang, one of the Deep Mind team, revealed that it had rectified the problem that occurred during the 4th game of the match between AlphaGo and Lee Sedol, and that after move 78 (which was dubbed the "hand of God" by many professionals), it would play accurately and maintain Black's advantage, since before the error which resulted in the loss, AlphaGo was leading throughout the game and Lee's move was not credited as the one which won the game, but caused the program's computing powers to be diverted and confused. Aja Huang explained that AlphaGo's policy network of finding the most accurate move order and continuation did not precisely guide AlphaGo to make the correct continuation after move 78, since its value network did not determine Lee Sedol's 78th move as being the most likely, and therefore when the move was made AlphaGo could not make the right adjustment to the logical continuation.[[32]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-Aja_Huang_Conference-32)

**Unofficial online matches in late 2016 to early 2017[**[**edit**](https://en.wikipedia.org/w/index.php?title=AlphaGo&action=edit&section=4)**]**

On December 29 in 2016, a new account named "Magist" from South Korea began to play games with professional players on the [Tygem](https://en.wikipedia.org/wiki/Tygem) server. It changed its account name to "Master" on 30 December, then moved to the FoxGo server on 1 January 2017. On 4 January, DeepMind confirmed that the "Magister" and the "Master" were both played by an updated version of AlphaGo.[[33]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-Master-33)[[34]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-Nature-Master-34) As of 5 January 5 2017, AlphaGo's online record was 60 wins and 0 losses,[[35]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-WSJ_Mourn-35) including three victories over Go's top ranked player, [Ke Jie](https://en.wikipedia.org/wiki/Ke_Jie),[[36]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-36) who had been quietly briefed in advance that Master was a version of AlphaGo.[[35]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-WSJ_Mourn-35) After losing to Master, [Gu Li](https://en.wikipedia.org/wiki/Gu_Li) offered a bounty of 100,000 [yuan](https://en.wikipedia.org/wiki/Renminbi) (14,400 [USD](https://en.wikipedia.org/wiki/United_States_dollar)) to the first human player who could defeat Master.[[34]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-Nature-Master-34) Master played at the pace of 10 games per day. Many quickly suspected it to be an AI player due to little or no resting between games. Its adversaries included many world champions such as [Ke Jie](https://en.wikipedia.org/wiki/Ke_Jie), [Park Jeong-hwan](https://en.wikipedia.org/wiki/Park_Jeong-hwan), [Yuta Iyama](https://en.wikipedia.org/wiki/Yuta_Iyama), [Tuo Jiaxi](https://en.wikipedia.org/wiki/Tuo_Jiaxi), Mi Yuting, Shi Yue, [Chen Yaoye](https://en.wikipedia.org/wiki/Chen_Yaoye), Li Qincheng, [Gu Li](https://en.wikipedia.org/wiki/Gu_Li), [Chang Hao](https://en.wikipedia.org/wiki/Chang_Hao), Tang Weixing, [Fan Tingyu](https://en.wikipedia.org/wiki/Fan_Tingyu), [Zhou Ruiyang](https://en.wikipedia.org/wiki/Zhou_Ruiyang), [Jiang Weijie](https://en.wikipedia.org/wiki/Jiang_Weijie), [Chou Chun-hsun](https://en.wikipedia.org/wiki/Chou_Chun-hsun), [Kim Ji-seok](https://en.wikipedia.org/wiki/Kim_Ji-seok_(Go_player)), [Kang Dong-yun](https://en.wikipedia.org/wiki/Kang_Dong-yun), [Park Yeong-hun](https://en.wikipedia.org/wiki/Park_Yeong-hun), and [Won Seong-jin](https://en.wikipedia.org/wiki/Won_Seong-jin); national champions or world championship runners-up such as Lian Xiao, [Tan Xiao](https://en.wikipedia.org/wiki/Tan_Xiao), Meng Tailing, Dang Yifei, Huang Yunsong, [Yang Dingxin](https://en.wikipedia.org/wiki/Yang_Dingxin), Gu Zihao, Shin Jinseo, [Cho Han-seung](https://en.wikipedia.org/wiki/Cho_Han-seung), and An Sungjoon. All 60 games except one were fast paced games with three 20 or 30 seconds [byo-yomi](https://en.wikipedia.org/wiki/Byo-yomi). Master offered to extend the byo-yomi to one minute when playing with [Nie Weiping](https://en.wikipedia.org/wiki/Nie_Weiping) due to his old age. After winning its 59th game Master revealed itself in the chatroom to be controlled by Dr. [Aja Huang](https://en.wikipedia.org/wiki/Aja_Huang) of the DeepMind team,[[37]](https://en.wikipedia.org/wiki/AlphaGo" \l "cite_note-37) then changed its nationality to United Kingdom. After these games were completed, the co-founder of Google DeepMind, [Demis Hassabis](https://en.wikipedia.org/wiki/Demis_Hassabis) said in a tweet "we're looking forward to playing some official, full-length games later [2017] in collaboration with Go organizations and experts".[[33]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-Master-33)[[34]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-Nature-Master-34)

Human players tend to make more mistakes in fast paced online games than in full-length tournament games due to short response time. It isn't definitively known whether AlphaGo will succeed as well in tournaments as it has online.[[34]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-Nature-Master-34) However, Go experts are extremely impressed by AlphaGo's performance and by its nonhuman play style; Ke Jie stated that "After humanity spent thousands of years improving our tactics, computers tell us that humans are completely wrong... I would go as far as to say not a single human has touched the edge of the truth of Go."[[35]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-WSJ_Mourn-35)

**Hardware[[edit](https://en.wikipedia.org/w/index.php?title=AlphaGo&action=edit&section=5" \o "Edit section: Hardware)]**

An early version of AlphaGo was tested on hardware with various numbers of [CPUs](https://en.wikipedia.org/wiki/Central_processing_unit) and [GPUs](https://en.wikipedia.org/wiki/Graphics_processing_unit), running in asynchronous or distributed mode. Two seconds of thinking time was given to each move. The resulting [Elo ratings](https://en.wikipedia.org/wiki/Elo_rating_system) are listed below.[[7]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-DeepMindnature2016-7) In the matches with more time per move higher ratings are achieved.

| Configuration and performance | | | | |
| --- | --- | --- | --- | --- |
| **Configuration** | **Search threads** | **No. of CPU** | **No. of GPU** | **Elo rating** |
| Single[[7]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-DeepMindnature2016-7) p. 10-11 | 40 | 48 | 1 | 2,181 |
| Single | 40 | 48 | 2 | 2,738 |
| Single | 40 | 48 | 4 | 2,850 |
| Single | 40 | 48 | 8 | 2,890 |
| [Distributed](https://en.wikipedia.org/wiki/Distributed_computing) | 12 | 428 | 64 | 2,937 |
| Distributed | 24 | 764 | 112 | 3,079 |
| Distributed | 40 | 1,202 | 176 | 3,140 |
| Distributed | 64 | 1,920 | 280 | 3,168 |

In May 2016, Google unveiled its own proprietary hardware "[tensor processing units](https://en.wikipedia.org/wiki/Tensor_processing_unit)", which it stated had already been deployed in multiple internal projects at Google, including the AlphaGo match against Lee Sedol.[[38]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-38)[[39]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-39)

**Algorithm[[edit](https://en.wikipedia.org/w/index.php?title=AlphaGo&action=edit&section=6" \o "Edit section: Algorithm)]**

As of 2016, AlphaGo's algorithm uses a combination of [machine learning](https://en.wikipedia.org/wiki/Machine_learning) and [tree search](https://en.wikipedia.org/wiki/Tree_search) techniques, combined with extensive training, both from human and computer play. It uses [Monte Carlo tree search](https://en.wikipedia.org/wiki/Monte_Carlo_tree_search), guided by a "value network" and a "policy network," both implemented using [deep neural network](https://en.wikipedia.org/wiki/Deep_neural_network) technology.[[2]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-googlego-2)[[7]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-DeepMindnature2016-7) A limited amount of game-specific feature detection pre-processing (for example, to highlight whether a move matches a [nakade](https://en.wikipedia.org/wiki/List_of_Go_terms#Nakade) pattern) is applied to the input before it is sent to the neural networks.[[7]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-DeepMindnature2016-7)

The system's neural networks were initially bootstrapped from human gameplay expertise. AlphaGo was initially trained to mimic human play by attempting to match the moves of expert players from recorded historical games, using a database of around 30 million moves.[[14]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-MetzWired2016-14) Once it had reached a certain degree of proficiency, it was trained further by being set to play large numbers of games against other instances of itself, using [reinforcement learning](https://en.wikipedia.org/wiki/Reinforcement_learning) to improve its play.[[2]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-googlego-2) To avoid "disrespectfully" wasting its opponent's time, the program is specifically programmed to resign if its assessment of win probability falls beneath a certain threshold; for the March 2016 match against Lee, the resignation threshold was set to 20%.[[40]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-40)

**Style of play[[edit](https://en.wikipedia.org/w/index.php?title=AlphaGo&action=edit&section=7" \o "Edit section: Style of play)]**

Toby Manning, the match referee for AlphaGo vs. Fan Hui, has described the program's style as "conservative".[[41]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-:0-41) AlphaGo's playstyle strongly favours greater probability of winning by fewer points over lesser probability of winning by more points.[[11]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-pcworld_unusual-11) Its strategy of maximising its probability of winning is distinct from what human players tend to do which is to maximise territorial gains, and explains some of its odd-looking moves.[[42]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-42)

**Responses to 2016 victory against Lee Sedol[[edit](https://en.wikipedia.org/w/index.php?title=AlphaGo&action=edit&section=8" \o "Edit section: Responses to 2016 victory against Lee Sedol)]**

**AI community[[edit](https://en.wikipedia.org/w/index.php?title=AlphaGo&action=edit&section=9" \o "Edit section: AI community)]**

AlphaGo's March 2016 victory was a major milestone in artificial intelligence research.[[43]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-latimes_milestone-43) Go had previously been regarded as a hard problem in machine learning that was expected to be out of reach for the technology of the time.[[43]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-latimes_milestone-43)[[44]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-44)[[45]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-45) Most experts thought a Go program as powerful as AlphaGo was at least five years away;[[46]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-46) some experts thought that it would take at least another decade before computers would beat Go champions.[[7]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-DeepMindnature2016-7)[[47]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-cbc_sweeps-47)[[48]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-48) Most observers at the beginning of the 2016 matches expected Lee to beat AlphaGo.[[43]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-latimes_milestone-43)

With games such as checkers (that has been "[solved](https://en.wikipedia.org/wiki/Solved_game)" by the [Chinook draughts player](https://en.wikipedia.org/wiki/Chinook_(draughts_player)) team), chess, and now Go won by computers, victories at popular board games can no longer serve as major milestones for artificial intelligence in the way that they used to. [Deep Blue](https://en.wikipedia.org/wiki/Deep_Blue_(chess_computer))'s [Murray Campbell](https://en.wikipedia.org/wiki/Murray_Campbell) called AlphaGo's victory "the end of an era... board games are more or less done and it's time to move on."[[43]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-latimes_milestone-43)

When compared with Deep Blue or with [Watson](https://en.wikipedia.org/wiki/Watson_(computer)), AlphaGo's underlying algorithms are potentially more general-purpose, and may be evidence that the scientific community is making progress towards [artificial general intelligence](https://en.wikipedia.org/wiki/Artificial_general_intelligence).[[11]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-pcworld_unusual-11)[[49]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-49) Some commentators believe AlphaGo's victory makes for a good opportunity for society to start discussing preparations for the possible future impact of [machines with general purpose intelligence](https://en.wikipedia.org/wiki/Artificial_general_intelligence). (As noted by entrepreneur Guy Suter, AlphaGo itself only knows how to play Go, and doesn't possess general purpose intelligence: "[It] couldn't just wake up one morning and decide it wants to learn how to use firearms"[[43]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-latimes_milestone-43)) In March 2016, AI researcher [Stuart Russell](https://en.wikipedia.org/wiki/Stuart_J._Russell) stated that "AI methods are progressing much faster than expected, (which) makes the question of the long-term outcome more urgent," adding that "in order to ensure that increasingly powerful AI systems remain completely under human control... there is a lot of work to do."[[50]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-phys.org_eye-50) Some scholars, such as [Stephen Hawking](https://en.wikipedia.org/wiki/Stephen_Hawking), warned (in May 2015 before the matches) that some future self-improving AI could gain actual general intelligence, leading to an unexpected [AI takeover](https://en.wikipedia.org/wiki/AI_takeover); other scholars disagree: AI expert Jean-Gabriel Ganascia believes that "Things like '[common sense](https://en.wikipedia.org/wiki/Common_sense)'... may never be reproducible",[[51]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-phys.org_challenge-51) and says "I don't see why we would speak about fears. On the contrary, this raises hopes in many domains such as health and space exploration."[[50]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-phys.org_eye-50) Computer scientist [Richard Sutton](https://en.wikipedia.org/wiki/Richard_S._Sutton) "I don't think people should be scared... but I do think people should be paying attention."[[52]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-52)

**Go community[[edit](https://en.wikipedia.org/w/index.php?title=AlphaGo&action=edit&section=10" \o "Edit section: Go community)]**

Go is a popular game in China, Japan and Korea, and the 2016 matches were watched by perhaps a hundred million people worldwide.[[43]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-latimes_milestone-43)[[53]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-53) Many top Go players characterized AlphaGo's unorthodox plays as seemingly-questionable moves that initially befuddled onlookers, but made sense in hindsight:[[47]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-cbc_sweeps-47) "All but the very best Go players craft their style by imitating top players. AlphaGo seems to have totally original moves it creates itself."[[43]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-latimes_milestone-43) AlphaGo appeared to have unexpectedly become much stronger, even when compared with its October 2015 match[[54]](https://en.wikipedia.org/wiki/AlphaGo" \l "cite_note-54) where a computer had beat a Go professional for the first time ever without the advantage of a handicap.[[55]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-nature_react-55) The day after Lee's first defeat, Jeong Ahram, the lead Go correspondent for one of South Korea’s biggest daily newspapers, said "Last night was very gloomy... Many people drank alcohol."[[56]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-56) The [Korea Baduk Association](https://en.wikipedia.org/wiki/Korea_Baduk_Association), the organization that oversees Go professionals in South Korea, awarded AlphaGo an honorary 9-dan title for exhibiting creative skills and pushing forward the game's progress.[[57]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-57)

China's [Ke Jie](https://en.wikipedia.org/wiki/Ke_Jie), an 18-year-old generally recognized as the world's best Go player,[[25]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-goratings.org_2016-25)[[58]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-telegraph_china-58) initially claimed that he would be able to beat AlphaGo, but declined to play against it for fear that it would "copy my style".[[58]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-telegraph_china-58) As the matches progressed, Ke Jie went back and forth, stating that "it is highly likely that I (could) lose" after analysing the first three matches,[[59]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-59) but regaining confidence after AlphaGo displayed flaws in the fourth match.[[60]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-60)

Toby Manning, the referee of AlphaGo's match against Fan Hui, and Hajin Lee, secretary general of the [International Go Federation](https://en.wikipedia.org/wiki/International_Go_Federation), both reason that in the future, Go players will get help from computers to learn what they have done wrong in games and improve their skills.[[55]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-nature_react-55)

After game two, Lee said he felt "speechless": "From the very beginning of the match, I could never manage an upper hand for one single move. It was AlphaGo's total victory."[[61]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-61) Lee apologized for his losses, stating after game three that "I misjudged the capabilities of AlphaGo and felt powerless."[[43]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-latimes_milestone-43) He emphasized that the defeat was "Lee Se-dol's defeat" and "not a defeat of mankind".[[27]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-koreatimes_beatable-27)[[51]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-phys.org_challenge-51) Lee said his eventual loss to a machine was "inevitable" but stated that "robots will never understand the beauty of the game the same way that we humans do."[[51]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-phys.org_challenge-51) Lee called his game four victory a "priceless win that I (would) not exchange for anything."[[27]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-koreatimes_beatable-27)

**Similar systems[[edit](https://en.wikipedia.org/w/index.php?title=AlphaGo&action=edit&section=11" \o "Edit section: Similar systems)]**

[Facebook](https://en.wikipedia.org/wiki/Facebook) has also been working on their own Go-playing system [*darkforest*](https://en.wikipedia.org/wiki/Darkforest), also based on combining machine learning and tree search.[[41]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-:0-41)[[62]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-facebook-paper-62) Although a strong player against other computer Go programs, as of early 2016, it had not yet defeated a professional human player.[[63]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-63) darkforest has lost to CrazyStone and Zen and is estimated to be of similar strength to CrazyStone and Zen.[[64]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-64)

[DeepZenGo](https://en.wikipedia.org/wiki/Zen_(software)), a system developed with support from video-sharing website [Dwango](https://en.wikipedia.org/wiki/Dwango_(company)) and the [University of Tokyo](https://en.wikipedia.org/wiki/University_of_Tokyo), lost 2-1 in November 2016 to Go master [Cho Chikun](https://en.wikipedia.org/wiki/Cho_Chikun), who holds the record for the largest number of Go title wins in Japan.[[65]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-65)[[66]](https://en.wikipedia.org/wiki/AlphaGo#cite_note-66)

**알파고**

위키백과, 우리 모두의 백과사전.

([AlphaGo](https://ko.wikipedia.org/w/index.php?title=AlphaGo&redirect=no" \o "AlphaGo)에서 넘어옴)

이동: [둘러보기](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#mw-head), [검색](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#p-search)

[https://upload.wikimedia.org/wikipedia/commons/thumb/4/4a/Disambig_grey.svg/23px-Disambig_grey.svg.png](https://ko.wikipedia.org/wiki/%EC%9C%84%ED%82%A4%EB%B0%B1%EA%B3%BC:%EB%8F%99%EC%9D%8C%EC%9D%B4%EC%9D%98%EC%96%B4_%EB%AC%B8%EC%84%9C)이탈리아의 도시에 대해서는 [알파고 (이탈리아)](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0_(%EC%9D%B4%ED%83%88%EB%A6%AC%EC%95%84)) 문서를 참조하십시오.

[https://upload.wikimedia.org/wikipedia/commons/thumb/0/0b/Alphago_logo_Reversed.svg/240px-Alphago_logo_Reversed.svg.png](https://commons.wikimedia.org/wiki/File:Alphago_logo_Reversed.svg?uselang=ko)

알파고 로고.

**알파고**([영어](https://ko.wikipedia.org/wiki/%EC%98%81%EC%96%B4): AlphaGo)는 [구글 딥마인드](https://ko.wikipedia.org/wiki/%EA%B5%AC%EA%B8%80_%EB%94%A5%EB%A7%88%EC%9D%B8%EB%93%9C)가 개발한 [인공지능](https://ko.wikipedia.org/wiki/%EC%9D%B8%EA%B3%B5%EC%A7%80%EB%8A%A5)(AI) [바둑](https://ko.wikipedia.org/wiki/%EB%B0%94%EB%91%91) [프로그램](https://ko.wikipedia.org/wiki/%EC%BB%B4%ED%93%A8%ED%84%B0_%ED%94%84%EB%A1%9C%EA%B7%B8%EB%9E%A8)이다.

2015년 10월 판 후이 2단과의 5번기에서 모두 승리해 핸디캡([접바둑](https://ko.wikipedia.org/wiki/%EC%A0%91%EB%B0%94%EB%91%91)) 없이 호선(맞바둑)으로 프로 바둑 기사를 이긴 최초의 컴퓨터 바둑 프로그램이 되었다.[[1]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-googlego-1) 2016년 3월에는 세계 최상위 수준급의 프로 기사인 [이세돌](https://ko.wikipedia.org/wiki/%EC%9D%B4%EC%84%B8%EB%8F%8C) 9단과의 5번기 공개 대국에서 대부분의 예상을 깨고 최종전적 4승 1패로 승리해 현존 최고 AI로 등극하면서 세계를 놀라게 했다. 이 대국을 통해 인공지능의 새 장을 열었다는 평가를 받았으며, 바둑계는 기존의 통념을 깨뜨리는 창의적인 수와 대세관으로 수 천년 동안 이어진 패러다임이 바뀔 것으로 전망했다. [한국기원](https://ko.wikipedia.org/wiki/%ED%95%9C%EA%B5%AD%EA%B8%B0%EC%9B%90)은 알파고가 정상의 프로기사 실력인 '입신'(入神)의 경지에 올랐다고 인정하고 프로 명예 단증(9단)을 수여했다.

딥마인드가 2014년 구글에 인수되면서 본격적인 개발에 착수한 알파고는 완성단계가 아닌 [프로토타입](https://ko.wikipedia.org/wiki/%ED%94%84%EB%A1%9C%ED%86%A0%ED%83%80%EC%9E%85) 단계로 2016년 현재 개발이 진행중이다. 데이비 하사비스 CEO와 구글은 알파고 알고리즘을 활용해 기후변화예측, 질병진단 및 건강관리, 무인자율주행차, 스마트폰 개인비서 등 미래의 핵심적 서비스 사업에 적용한다는 계획이다.

알파고라는 이름은 [구글](https://ko.wikipedia.org/wiki/%EA%B5%AC%EA%B8%80)의 지주회사 이름인 [알파벳](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EB%B2%B3_(%EA%B8%B0%EC%97%85))과, 그리스 문자의 첫 번째 글자로 최고를 의미하는 '[알파](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C)(α)'와 '碁(바둑)'의 일본어 발음에서 유래한 영어 단어 'Go'를 뜻한다.[[2]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-2)

**목차**

 [숨기기]

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* [6 사회적 반향](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#.EC.82.AC.ED.9A.8C.EC.A0.81_.EB.B0.98.ED.96.A5)
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**개발 역사와 대전[**[**편집**](https://ko.wikipedia.org/w/index.php?title=%EC%95%8C%ED%8C%8C%EA%B3%A0&action=edit&section=1)**]**

**인간 대 바둑 프로그램[**[**편집**](https://ko.wikipedia.org/w/index.php?title=%EC%95%8C%ED%8C%8C%EA%B3%A0&action=edit&section=2)**]**

[바둑](https://ko.wikipedia.org/wiki/%EB%B0%94%EB%91%91)은 [체스](https://ko.wikipedia.org/wiki/%EC%B2%B4%EC%8A%A4)와 같은 다른 게임에 비해 컴퓨터가 인간을 이기기 훨씬 어려운 것으로 여겨지고 있다. 체스 등보다 가능한 국면의 수가 훨씬 크기 때문에, [브루트 포스](https://ko.wikipedia.org/w/index.php?title=%EB%B8%8C%EB%A3%A8%ED%8A%B8_%ED%8F%AC%EC%8A%A4&action=edit&redlink=1) 등 전통적인 AI 기법 적용이 매우 곤란하기 때문이다.[[1]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-googlego-1)

1997년 [IBM](https://ko.wikipedia.org/wiki/IBM)의 컴퓨터 [딥 블루](https://ko.wikipedia.org/wiki/%EB%94%A5_%EB%B8%94%EB%A3%A8)가 세계 체스 챔피언 [가리 카스파로프](https://ko.wikipedia.org/wiki/%EA%B0%80%EB%A6%AC_%EC%B9%B4%EC%8A%A4%ED%8C%8C%EB%A1%9C%ED%94%84)를 이기고 20년 정도 지나 [인공 지능](https://ko.wikipedia.org/wiki/%EC%9D%B8%EA%B3%B5_%EC%A7%80%EB%8A%A5) 기술을 사용한 가장 강한 바둑 프로그램이 인간 아마추어 기사 5단의 수준에 도달했지만,[[3]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-DeepMindnature2016-3) 여전히 핸디캡 없이 프로 바둑 기사를 이기진 못했다.[[1]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-googlego-1)[[4]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-bbcgo-4)[[5]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-CNN0128-5) 2012년, 4대의 PC 클러스터로 운용되는 프로그램 '젠'(Zen)은 프로 기사 [다케미야 마사키](https://ko.wikipedia.org/wiki/%EB%8B%A4%EC%BC%80%EB%AF%B8%EC%95%BC_%EB%A7%88%EC%82%AC%ED%82%A4) 9단과의 4점 접바둑으로 5전 2승을 거두었고, 프랑스에서 개발된 '크레이지 스톤'은 2013년, [이시다 요시오](https://ko.wikipedia.org/wiki/%EC%9D%B4%EC%8B%9C%EB%8B%A4_%EC%9A%94%EC%8B%9C%EC%98%A4) 9단과의 4점 접바둑에서 이겼다.

**알파고[**[**편집**](https://ko.wikipedia.org/w/index.php?title=%EC%95%8C%ED%8C%8C%EA%B3%A0&action=edit&section=3)**]**

알파고는 이전 바둑 프로그램보다 현저한 발전을 이루었다. 알파고는 단일 컴퓨터로 구동되는 '단일 버전(Single version)'과 네트워크에 연결된 여러대의 컴퓨터를 사용하는 '분산 버전(Distributed version)' 두 가지가 있으며, 2015년 10월의 분산 버전은 1,202개의 [CPU](https://ko.wikipedia.org/wiki/CPU)와 176개의 [GPU](https://ko.wikipedia.org/wiki/GPU)로 구성되어 있었다.[[3]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-DeepMindnature2016-3)

단일 버전의 알파고는 '크레이지 스톤'과 '젠'을 포함한 다른 바둑 프로그램과의 500번의 대국에서 1번을 제외하고는 모두 이겼다.[[6]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-6)[[7]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-7)

현재버전의 알파고는 ELO레이팅 점수가 4500점대로 추산된다. 바둑에서 인간역사상 가장 높은 ELO레이팅점수가 3600점인데, 1000점의 차이면 정선 정도의 차이라고 한다. 맞바둑(호선)으로는 현재 인류최강자로써는 100판을 둬도 한판을 이기기 어렵다. 1000판중에서도 6~8판정도 이길 수 있다고 한다. 따라서 현재로써는 바둑으로 인간이 알파고를 이길 수 있는 방법이 전무하다고 알려져있다.

**프로 기사와의 대국[**[**편집**](https://ko.wikipedia.org/w/index.php?title=%EC%95%8C%ED%8C%8C%EA%B3%A0&action=edit&section=4)**]**

판 후이 2단

2015년 10월, 분산 버전의 알파고(버전12)는 2013~2015년 유럽 [바둑](https://ko.wikipedia.org/wiki/%EB%B0%94%EB%91%91) 챔피언인 프로 기사 판 후이 2단과의 5번기에서 5대0으로 이겼다.[[8]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-MetzWired2016-8)[[4]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-bbcgo-4)[[9]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-9) 이는 컴퓨터 프로그램이 19×19 바둑판 위의 대국에서 프로 기사를 이긴 최초의 경기였다.[[10]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-lemondego-10) 대국 결과는 알고리즘을 설명한 관련 논문이 실린 과학 저널 [네이처](https://ko.wikipedia.org/wiki/%EB%84%A4%EC%9D%B4%EC%B2%98)의 출판일에 맞추어 지연 발표되면서 2016년 1월 27일 이후 알려졌다.[[3]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-DeepMindnature2016-3)[[4]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-bbcgo-4)

이세돌 9단

2016년 3월, 분산 버전의 알파고(버전18)는 프로 기사 이세돌 9단과의 5번기 대국에서 4대 1로 이겼다. 이 대국은 경기가 벌어진 [대한민국](https://ko.wikipedia.org/wiki/%EB%8C%80%ED%95%9C%EB%AF%BC%EA%B5%AD)을 포함하여 전 세계로 생중계되었으며, 인공지능 알파고가 최고 수준의 바둑 기사를 상대로 한 승리는 사회에 큰 반향을 불러일으켰다.

**하드웨어[**[**편집**](https://ko.wikipedia.org/w/index.php?title=%EC%95%8C%ED%8C%8C%EA%B3%A0&action=edit&section=5)**]**

알파고는 다양한 수의 [CPU](https://ko.wikipedia.org/wiki/%EC%A4%91%EC%95%99_%EC%B2%98%EB%A6%AC_%EC%9E%A5%EC%B9%98)와 [GPU](https://ko.wikipedia.org/wiki/%EA%B7%B8%EB%9E%98%ED%94%BD_%EC%B2%98%EB%A6%AC_%EC%9E%A5%EC%B9%98)에서 비동기 모드와 분산 모드로 테스트되었다. 한 수당 생각할 시간은 2초씩 배정되었다. [엘로 평점](https://ko.wikipedia.org/wiki/%EC%97%98%EB%A1%9C_%ED%8F%89%EC%A0%90_%EC%8B%9C%EC%8A%A4%ED%85%9C)은 아래와 같다.[[3]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-DeepMindnature2016-3)

| 배열 및 성능 | | | | |
| --- | --- | --- | --- | --- |
| **배열** | **검색 쓰레드** | **CPU 수** | **GPU 수** | **엘로 평점** |
| 비동기 | 40 | 48 | 1 | 2,151 |
| 비동기 | 40 | 48 | 2 | 2,738 |
| 비동기 | 40 | 48 | 4 | 2,850 |
| 비동기 | 40 | 48 | 8 | 2,890 |
| 분산 | 12 | 428 | 64 | 2,937 |
| 분산 | 24 | 764 | 112 | 3,079 |
| 분산 | 40 | 1,202 | 176 | 3,140 |
| 분산 | 64 | 1,920 | 280 | 3,168 |

**알고리즘[**[**편집**](https://ko.wikipedia.org/w/index.php?title=%EC%95%8C%ED%8C%8C%EA%B3%A0&action=edit&section=6)**]**

[알고리즘](https://ko.wikipedia.org/wiki/%EC%95%8C%EA%B3%A0%EB%A6%AC%EC%A6%98)은 [머신 러닝](https://ko.wikipedia.org/wiki/%EB%A8%B8%EC%8B%A0_%EB%9F%AC%EB%8B%9D)과 [트리 순회](https://ko.wikipedia.org/wiki/%ED%8A%B8%EB%A6%AC_%EC%88%9C%ED%9A%8C) 기술을 조합, 인간과 컴퓨터 모두와의 대규모의 연습과 결합한다. 이 알고리즘은 [심층 신경망](https://ko.wikipedia.org/wiki/%EB%94%A5_%EB%9F%AC%EB%8B%9D#.EC.8B.AC.EC.B8.B5_.EC.8B.A0.EA.B2.BD.EB.A7.9D.28Deep_Neural_Network.2C_DNN.29) 기술로 구현한 '가치 네트워크'와 '정책 네트워크'에 인도되는 [몬테카를로 트리 순회](https://ko.wikipedia.org/wiki/%EB%AA%AC%ED%85%8C%EC%B9%B4%EB%A5%BC%EB%A1%9C_%ED%8A%B8%EB%A6%AC_%EC%88%9C%ED%9A%8C)를 사용한다.[[1]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-googlego-1)[[3]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-DeepMindnature2016-3) 한정된 양의 게임 전용 특징 탐지 전처리로 신경망 입력을 만들어 낸다.[[3]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-DeepMindnature2016-3)

최초에 시스템의 신경망은 인간의 게임 플레이 전문 기술로 [부트스트랩](https://ko.wikipedia.org/wiki/%EB%B6%80%ED%8C%85)되었다. 알파고는 처음에는 3천 만 수 정도의 데이터베이스를 사용, 기록된 역사적인 게임으로부터 기사(棋士)의 움직임의 연결을 시도, 인간의 바둑 두기를 흉내내도록 훈련되었다.[[8]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-MetzWired2016-8) 알파고가 어느 정도 숙달되자, [강화 학습](https://ko.wikipedia.org/wiki/%EA%B0%95%ED%99%94_%ED%95%99%EC%8A%B5)을 통하여 또 다른 자신과 많은 대국을 하게 하는 방식으로 훈련, 경기력을 향상시켰다.[[1]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-googlego-1)

**프로 바둑 기사와의 대국[**[**편집**](https://ko.wikipedia.org/w/index.php?title=%EC%95%8C%ED%8C%8C%EA%B3%A0&action=edit&section=7)**]**

**판 후이 2단과의 대국[**[**편집**](https://ko.wikipedia.org/w/index.php?title=%EC%95%8C%ED%8C%8C%EA%B3%A0&action=edit&section=8)**]**

2015년 10월 알파고(버전12)와 프로 기사 판 후이 2단과의 대국은 제한시간 1시간, 초읽기 30초 3회, 7집 반 [덤](https://ko.wikipedia.org/wiki/%EB%8D%A4_(%EB%B0%94%EB%91%91)) 중국 규칙을 적용하며 진행되었으며, 5번기에서 알파고가 5대0으로 이겼다.[[8]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-MetzWired2016-8)[[4]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-bbcgo-4)[[3]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-DeepMindnature2016-3)

대국 예

알파고(흑) 대 판 후이 2단(백), 제4국 (2015년 10월 8일), 알파고 불계승.[[3]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-DeepMindnature2016-3)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| | Go l.svg | Go 58.svg | Go 56.svg | Go b3.svg | Go 63.svg | Go 22.svg | Go board diagram image.svg | Go board diagram image.svg | Go 23.svg | Go -.svg | Go board diagram image.svg | Go 86.svg | Go 88.svg | Go 93.svg | Go 92.svg | Go 98.svg | Go w8.svg | Go board diagram image.svg | Go r.svg | | Go l.svg | Go 52.svg | Go board diagram image.svg | Go 60.svg | Go 61.svg | Go board diagram image.svg | Go board diagram image.svg | Go 24.svg | Go 25.svg | Go board diagram image.svg | Go 90.svg | Go board diagram image.svg | Go board diagram image.svg | Go 94.svg | Go board diagram image.svg | Go b5.svg | Go w6.svg | Go board diagram image.svg | Go r.svg | | Go l.svg | Go board diagram image.svg | Go 62.svg | Go 19.svg | Go board diagram image.svg | Go board diagram image.svg | Go 28.svg | Go 27.svg | Go 29.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go b7.svg | Go board diagram image.svg | Go r.svg | | Go l.svg | Go board diagram image.svg | Go 50.svg | Go board diagram image.svg | Go 33.svg | Go 39.svg | Go 30.svg | Go 26.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go b9.svg | Go board diagram image.svg | Go board diagram image.svg | Go r.svg | | Go l.svg | Go 74.svg | Go board diagram image.svg | Go 32.svg | Go 36.svg | Go 37.svg | Go board diagram image.svg | Go board diagram image.svg | Go 34.svg | Go 31.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go r.svg | | Go l.svg | Go 72.svg | Go 73.svg | Go board diagram image.svg | Go board diagram image.svg | Go 38.svg | Go 41.svg | Go 47.svg | Go board diagram image.svg | Go 35.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go r.svg | | Go l.svg | Go board diagram image.svg | Go 49.svg | Go 15.svg | Go 40.svg | Go 46.svg | Go 42.svg | Go 43.svg | Go board diagram image.svg | Go -.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go -.svg | Go board diagram image.svg | Go board diagram image.svg | Go r.svg | | Go l.svg | Go board diagram image.svg | Go 51.svg | Go 44.svg | Go board diagram image.svg | Go board diagram image.svg | Go 45.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram 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diagram image.svg | Go board diagram image.svg | Go 75.svg | Go board diagram image.svg | Go r.svg | | Go l.svg | Go board diagram image.svg | Go board diagram image.svg | Go b1.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go 20.svg | Go -.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go w2.svg | Go 78.svg | Go board diagram image.svg | Go r.svg | | Go l.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go 16.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go 99.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go 14.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go r.svg | | 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| 처음 99수 (96은 10의 자리) |

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| 100~165수. |

**이세돌 9단과의 대국[**[**편집**](https://ko.wikipedia.org/w/index.php?title=%EC%95%8C%ED%8C%8C%EA%B3%A0&action=edit&section=9)**]**

https://upload.wikimedia.org/wikipedia/commons/thumb/e/ec/Crystal_Clear_app_xmag.svg/16px-Crystal_Clear_app_xmag.svg.png이 부분의 본문은 [알파고 대 이세돌](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0_%EB%8C%80_%EC%9D%B4%EC%84%B8%EB%8F%8C)입니다.

구글은 대한민국의 프로 기사 [이세돌](https://ko.wikipedia.org/wiki/%EC%9D%B4%EC%84%B8%EB%8F%8C) 9단과 대국을 성사시켜 2016년 3월 9일부터 15일까지 서울의 [포 시즌스 호텔](https://ko.wikipedia.org/wiki/%ED%8F%AC_%EC%8B%9C%EC%A6%8C%EC%8A%A4_%ED%98%B8%ED%85%94)에서 [구글 딥마인드 챌린지 매치](https://ko.wikipedia.org/wiki/%EA%B5%AC%EA%B8%80_%EB%94%A5%EB%A7%88%EC%9D%B8%EB%93%9C_%EC%B1%8C%EB%A6%B0%EC%A7%80_%EB%A7%A4%EC%B9%98)를 개최하였다.[[5]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-CNN0128-5) 대국은 5전 3선승제이며 보통 일반 기전과 달리 승패에 상관없이 5국까지 모두 진행하였다.[[11]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-11)[[12]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-12) 대국 일정과 결과는 다음과 같다.[[13]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-13)[[14]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-14)

* 3월 9일 제1국 186수, 백 불계승
* 3월 10일 제2국 211수, 흑 불계승
* 3월 12일 제3국 176수, 백 불계승
* 3월 13일 제4국 180수, 흑 불계패
* 3월 15일 제5국 280수, 백 불계승

인간과 인공지능의 대결, 문화와 과학의 대결 등으로 수많은 화재를 불러일으키며 역사적인 세기의 대결로 주목받은 이 대국은 [유투브](https://ko.wikipedia.org/wiki/%EC%9C%A0%ED%88%AC%EB%B8%8C)(YouTube)를 통해 전세계에 생중계되었으며, 한국어와 영어로 공식해설이 제공되었다. 대한민국에서는 [한국방송공사](https://ko.wikipedia.org/wiki/%ED%95%9C%EA%B5%AD%EB%B0%A9%EC%86%A1%EA%B3%B5%EC%82%AC)(KBS2)을 통하여 첫 대국이 생방송되었다.[[15]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-15)[[16]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-16) 이 대국의 알파고는 판 후이 2단과의 대국했을 때와 비슷한 수준의 분산 버전(버전18)으로 영국의 구글 딥마인트 본사에서 운용하고, 미국에 중서부에 위치한 구글의 클라우드 서버에서 구동되었으며, 구글의 연구개발자이자 아마추어 6단인 아자 황이 알파고 대신 [바둑판](https://ko.wikipedia.org/wiki/%EB%B0%94%EB%91%91%ED%8C%90)에 돌을 놓고, 이세돌 9단이 착점한 수를 컴퓨터에 입력하는 방식으로 진행되었다.[[17]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-JoongAng_Ilbo-17) 중국 규칙을 따라 7점 반의 [덤](https://ko.wikipedia.org/wiki/%EB%8D%A4_(%EB%B0%94%EB%91%91))을 적용하여 공제하며, 양측은 제한시간 2시간씩, 초읽기는 60초 3회가 주어졌다.[[18]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-Korea_Baduk_Association-18)

알파고는 치밀하고 정교한 수 읽기와 정확한 집계산 능력을 앞세워 1~3국을 연속으로 승리하여 우승을 확정지었으며, 미화 100만 달러의 우승 상금은 [유니세프](https://ko.wikipedia.org/wiki/%EC%9C%A0%EB%8B%88%EC%84%B8%ED%94%84)와 STEM(과학·기술·공학·수학) 교육 및 바둑 관련 자선단체에 기부할 예정이다.[[19]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-19)

이세돌 9단은 4국에서 승리한 후 기자회견에서 “알파고가 노출시킨 약점은 두 가지다. 첫 번째 알파고는 백보다 흑을 힘들어했다. 두 번째는 자기가 생각하지 못했던 수가 나오면 버그 형태로 몇 수를 진행하는 것을 보았다. 알파고는 생각 못했을 경우 대처 능력이 떨어진다.”라고 지적하였고, [데이비 하사비스](https://ko.wikipedia.org/w/index.php?title=%EB%8D%B0%EC%9D%B4%EB%B9%84_%ED%95%98%EC%82%AC%EB%B9%84%EC%8A%A4&action=edit&redlink=1) 최고경영자(CEO)는 “신경망은 스스로 바둑을 두며 학습하도록 돼 있기 때문에 지식의 공백이 있을 수 밖에 없다. 이 9단과의 대국을 통해 이런 한계를 알 수 있었다.”고 설명하면서 패배를 통해 알파고의 한계를 알게 된 것을 이 대회의 성과로 꼽았다.

대국 예

* 2016년 3월 10일의 2국. 흑돌을 잡은 알파고가 불계승했다.

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| 100수 ~ 199수 |

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| 200수 ~ 211수 |

* 2016년 3월 13일의 4국. 백돌을 잡은 이세돌이 180수 끝에 불계승했다.(78수가 승부수)

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| 1수 ~ 99수 |

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image.svg | Go 44.svg | Go 65.svg | Go w.svg | Go w.svg | Go b.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go r.svg | | Go l.svg | Go board diagram image.svg | Go b.svg | Go -.svg | Go b.svg | Go w.svg | Go 27.svg | Go b.svg | Go w.svg | Go -.svg | Go 63.svg | Go board diagram image.svg | Go b.svg | Go b.svg | Go board diagram image.svg | Go b.svg | Go board diagram image.svg | Go 49.svg | Go r.svg | | Go l.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go 14.svg | Go 28.svg | Go w.svg | Go b.svg | Go 64.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go b.svg | Go w.svg | Go b.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go 47.svg | | Go l.svg | Go board diagram image.svg | Go board diagram image.svg | Go 21.svg | Go board diagram image.svg | Go w.svg | Go b.svg | Go 29.svg | Go 26.svg | Go board diagram image.svg | Go board diagram image.svg | Go b.svg | Go w.svg | Go w.svg | Go 75.svg | Go board diagram image.svg | Go 43.svg | Go 41.svg | Go 46.svg | | Go l.svg | Go 16.svg | Go w.svg | Go 17.svg | Go 18.svg | Go w.svg | Go b.svg | Go 03.svg | Go board diagram image.svg | Go w.svg | Go board diagram image.svg | Go board diagram image.svg | Go b.svg | Go w.svg | Go board diagram image.svg | Go b.svg | Go 42.svg | Go 36.svg | Go 48.svg | | Go 61.svg | Go 31.svg | Go 13.svg | Go 22.svg | Go w.svg | Go b.svg | Go w.svg | Go board diagram image.svg | Go 30.svg | Go w.svg | Go b.svg | Go b.svg | Go b.svg | Go w.svg | Go 73.svg | Go board diagram image.svg | Go 69.svg | Go 70.svg | Go r.svg | | Go 62.svg | Go board diagram image.svg | Go 32.svg | Go board diagram image.svg | Go w.svg | Go b.svg | Go 06.svg | Go board diagram image.svg | Go w.svg | Go b.svg | Go board diagram image.svg | Go b.svg | Go w.svg | Go bS.svg | Go w.svg | Go w.svg | Go w.svg | Go board diagram image.svg | Go r.svg | | Go l.svg | Go w.svg | Go w.svg | Go w.svg | Go b.svg | Go 07.svg | Go board diagram image.svg | Go b.svg | Go 04.svg | Go b.svg | Go b.svg | Go w.svg | Go w.svg | Go bT.svg | Go b.svg | Go b.svg | Go w.svg | Go 02.svg | Go 76.svg | | Go 52.svg | Go 51.svg | Go b.svg | Go b.svg | Go board diagram image.svg | Go b.svg | Go 67.svg | Go 24.svg | Go w.svg | Go board diagram image.svg | Go b.svg | Go board diagram image.svg | Go w.svg | Go w.svg | Go w.svg | Go b.svg | Go b.svg | Go b.svg | Go 01.svg | | Go l.svg | Go 50.svg | Go 53.svg | Go board diagram image.svg | Go board diagram image.svg | Go 11.svg | Go 10.svg | Go board diagram image.svg | Go board diagram image.svg | Go 08.svg | Go 09.svg | Go board diagram image.svg | Go b.svg | Go w.svg | Go board diagram image.svg | Go w.svg | Go w.svg | Go 00.svg | Go 74.svg | | Go l.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go 12.svg | Go board diagram image.svg | Go 23.svg | Go board diagram image.svg | Go 05.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go w.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go r.svg | | Go l.svg | Go 25.svg | Go b.svg | Go 37.svg | Go 19.svg | Go board diagram image.svg | Go board diagram image.svg | Go 54.svg | Go 55.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go r.svg | | Go l.svg | Go board diagram image.svg | Go w.svg | Go board diagram image.svg | Go w.svg | Go 20.svg | Go 34.svg | Go 33.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram 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Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go 35.svg | Go 39.svg | Go 40.svg | Go board diagram image.svg | Go r.svg | | Go dl.svg | Go d.svg | Go d.svg | Go 60.svg | Go 59.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go 71.svg | Go 72.svg | Go dr.svg | |
| 100수 ~ 180수 (177 자리에 [Go bS.svg](https://commons.wikimedia.org/wiki/File:Go_bS.svg?uselang=ko), 178 자리에 [Go bT.svg](https://commons.wikimedia.org/wiki/File:Go_bT.svg?uselang=ko)) |

**기풍, 기력[**[**편집**](https://ko.wikipedia.org/w/index.php?title=%EC%95%8C%ED%8C%8C%EA%B3%A0&action=edit&section=10)**]**

알파고는 응수타진이나 [사석작전](https://ko.wikipedia.org/wiki/%EB%B2%84%EB%A6%BC%EB%8F%8C)같은 소위 '인간적인' 전략을 능수능란하게 구사한다. [김명완](https://ko.wikipedia.org/wiki/%EA%B9%80%EB%AA%85%EC%99%84_(%EB%B0%94%EB%91%91_%EA%B8%B0%EC%82%AC)) 9단은 판 후이 2단과의 대국에서 알파고는 '사람 같다'고 묘사하였고,[[20]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-20) 경기 심판 토비 매닝은 프로그램의 방식을 '보수적'이라고 했다.[[21]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-:0-21) [김성룡](https://ko.wikipedia.org/wiki/%EA%B9%80%EC%84%B1%EB%A3%A1_(%EB%B0%94%EB%91%91_%EA%B8%B0%EC%82%AC)) 9단은 이세돌 9단과의 5국을 해설하면서 “[이창호](https://ko.wikipedia.org/wiki/%EC%9D%B4%EC%B0%BD%ED%98%B8_(%EB%B0%94%EB%91%91_%EA%B8%B0%EC%82%AC)) 9단이 새로운 기풍으로 바둑계를 놀라게 했던 것과 비슷한 느낌이다. 계산의 신(神算)으로 불렸던 이창호 9단의 전성기와 닮아있다”라고 설명하였다.

**사회적 반향[**[**편집**](https://ko.wikipedia.org/w/index.php?title=%EC%95%8C%ED%8C%8C%EA%B3%A0&action=edit&section=11)**]**

**과학계[**[**편집**](https://ko.wikipedia.org/w/index.php?title=%EC%95%8C%ED%8C%8C%EA%B3%A0&action=edit&section=12)**]**

바둑을 두는 것은 머신 러닝에서 어려운 문제로 평가되어 왔기에 알파고는 인공 지능 연구의 랜드마크적 성장으로 일컬어졌다.[[22]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-22)[[23]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-23)

대부분의 전문가들은 알파고와 같은 강력한 바둑 프로그램은 최소한 5년 후에나 가능할 것으로 생각했다.[[24]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-24) 일부 전문가는 컴퓨터가 바둑 챔피언을 이기려면 최소한 10년은 더 있어야 한다고 생각했다.[[25]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-cbc_sweeps-25)[[26]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-26)

2016년 3월에 개최된 알파고와 이세돌의 대결은 인공 지능 연구에 있어 획기적인 사건이었다. 대국 전에 대부분의 참관인들은 이세돌이 알파고를 이길 것으로 기대하였다.[[27]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-latimes_milestone-27) 하지만, 5차례의 대국에서 알파고는 이세돌을 4대 1로 이겼다.[[28]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-.EC.A0.84.EC.9E.90_0315-28)

체스와 함께 바둑에서도 컴퓨터가 사람을 이기면서 기존의 방식으로 인기 보드 게임에서 이기는 것은 더 이상 인공 지능의 중대 사건이 아니게 되었다. [딥 블루](https://ko.wikipedia.org/wiki/%EB%94%A5_%EB%B8%94%EB%A3%A8)의 머리 캠벨은 알파고의 승리를 '한 시대의 끝 … 보드 게임은 거의 마무리되었고 이제는 옮겨갈 때'라고 하였다.[[27]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-latimes_milestone-27)

딥 블루나 [왓슨](https://ko.wikipedia.org/wiki/%EC%99%93%EC%8A%A8_(%EC%BB%B4%ED%93%A8%ED%84%B0))과 비교하여 알파고의 근원적인 알고리즘은 보다 다목적인 잠재성이 있으며, 과학계가 [인공 일반 지능](https://ko.wikipedia.org/wiki/%EC%9D%B8%EA%B3%B5_%EC%9D%BC%EB%B0%98_%EC%A7%80%EB%8A%A5)(AGI, artificial general intelligence)으로 진전하고 있다는 증거일 수 있다.[[29]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-29)

일부 해설자들은 알파고의 승리는 사회에 있어 인공 일반 지능을 지닌 기계가 가져올 수 있는 미래의 충격에 대한 대비의 논의를 시작하는 좋은 기회를 가져다 주었다고 평가한다. AI 연구자 [스튜어트 러셀](https://ko.wikipedia.org/w/index.php?title=%EC%8A%A4%ED%8A%9C%EC%96%B4%ED%8A%B8_%EC%A1%B0%EB%82%98%EB%8B%A8_%EB%9F%AC%EC%85%80&action=edit&redlink=1)은 'AI의 체계성은 예상한 것보다 훨씬 빠르게 진척되고 있어서 장기적 성과에 대한 문제를 더욱 긴급하게 하고 있다'면서, '갈수록 강력해지는 AI 체계가 완전히 인간의 통제하에 남아 있음을 보장하기 위해서 … 할 일이 많다'고 하였다.[[30]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-phys.org_eye-30) [스티븐 호킹](https://ko.wikipedia.org/wiki/%EC%8A%A4%ED%8B%B0%EB%B8%90_%ED%98%B8%ED%82%B9)과 같은 일부 학자들은 미래의 자기 개량 AI는 사실상의 일반 지능을 얻을 수 있으며, 기대하지 않았던 AI 테이크오버(AI의 지구 장악)를 초래할 수 있다고 경고했다. 또 다른 학자들은 이에 동의하지 않으며, AI 전문가 장 가브리엘 가나시아는 '상식과 같은 것들은 … 영원히 복제할 수 없을 것'이라 하였다.[[31]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-phys.org_challenge-31) 또한, '우리가 왜 공포에 대해 말해야 하는지 모르겠다. 반대로, 이는 건강이나 우주 탐험 같은 여러 분야에서 희망을 높여주고 있다'고 했다.[[30]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-phys.org_eye-30) 컴퓨터 과학자 리처드 서튼은 '사람들이 두려워해야 한다고 생각하지 않지만 … 사람들은 주의해야만 한다'고 했다.[[32]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-32)

**바둑계[**[**편집**](https://ko.wikipedia.org/w/index.php?title=%EC%95%8C%ED%8C%8C%EA%B3%A0&action=edit&section=13)**]**

알파고와 판 후이의 경기의 심판이었던 토비 매닝과 [국제바둑연맹](https://ko.wikipedia.org/w/index.php?title=%EA%B5%AD%EC%A0%9C%EB%B0%94%EB%91%91%EC%97%B0%EB%A7%B9&action=edit&redlink=1)(IGF) 사무국장 이하진은 미래에는 바둑 참가자들은 대국에서 무엇을 잘못했는지를 알고, 기량을 향상시키기 위해 컴퓨터에 조언을 구하게 될 것이라 추측하였다.[[33]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-nature_react-33)

2016년 3월의 대국은 전 세계적으로 수백 만 명이 관람하고 분석하였다.[[27]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-latimes_milestone-27) 많은 바둑 기사들은 알파고의 정통적이지 않은 바둑을 처음에는 관람자들을 어리둥절하게 만들지만 다 알고 나면 이치에 맞는, 겉보기에 미심쩍은 행보로 묘사하였다.[[25]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-cbc_sweeps-25) 알파고는 인공지능으로서는 최초로 핸디캡 없이 프로 기사에 이긴 2015년 10월의 경기와 비교하더라도 예상 외로 강해진 듯했다.[[34]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-34)[[33]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-nature_react-33)

대국 전 이세돌은 '질 수도 있다'고 하면서 '바둑의 아름다움, 인간의 아름다움을 컴퓨터가 이해하고 두는 게 아니므로 바둑의 가치는 계속될 것'이라 했다.[[35]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-35) 이세돌은 3국 후 그의 패배를 인정하면서 '여러 가지로 알파고 능력을 오판한 것이 많았다'고 했고, '분명 약점이 있는 것 같다. 아직 정말 인간에게 메시지를 던질 수 있는 실력은 아니다.'라고 주장했다.[[36]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-36) 4국의 승리 후에는 이를 '무엇과도 바꿀 수 없는 가치 있는 승리'라고 했다.[[37]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-37)

중국의 바둑 1위이자 세계 랭킹 1위인 [커제](https://ko.wikipedia.org/wiki/%EC%BB%A4%EC%A0%9C)는 처음에는 알파고와 대국하여 이길 수 있다고 주장하였으나,[[38]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-38) 3국까지의 결과를 분석한 후에는 질 가능성이 크다고 언급하였다.[[39]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-39) 하지만, 이세돌이 1승을 거둔 대국 후에는 이길 수 있다고 믿는다고 했고, 알파고와의 대전을 트위터로 예고하였다.[[40]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-40)

**그 후 근황[**[**편집**](https://ko.wikipedia.org/w/index.php?title=%EC%95%8C%ED%8C%8C%EA%B3%A0&action=edit&section=14)**]**

[이세돌](https://ko.wikipedia.org/wiki/%EC%9D%B4%EC%84%B8%EB%8F%8C) 9단과의 대국이 끝난 뒤 구글 딥마인드의 데미스 하자비스는 2017년 1월 4일 자신의 트위터를 통해 국내의 바둑사이트 [타이젬](https://ko.wikipedia.org/wiki/%ED%83%80%EC%9D%B4%EC%A0%AC)과 다른 바둑사이트에서 신형 알파고가 'Magister(P)'라는 아이디로 실습을 했고 한중일 바둑기사들에게 총 60연승을 거뒀다는 사실을 밝혔다.

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Go 44.svg | Go board diagram image.svg | Go r.svg | | Go l.svg | Go board diagram image.svg | Go board diagram image.svg | Go 98.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go board diagram image.svg | Go r.svg | | Go dl.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go d.svg | Go dr.svg | |
| Magister(P) 대 인간 기사 (9단) |

이 과정에서 [박정환](https://ko.wikipedia.org/wiki/%EB%B0%95%EC%A0%95%ED%99%98) 9단, [커제](https://ko.wikipedia.org/wiki/%EC%BB%A4%EC%A0%9C) 9단이 3패로 무너졌다. 이세돌은 '알파고가 더 강해졌다'며 초읽기의 약점도 보완되었다고 평가했다.이어 '만약 알파고는 초읽기만 갖고 인간 기사는 2,3시간을 갖는다면 5판 중 1판은 이길 수 있을 것이라'고 전망했다.[[41]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-41)

**유사 시스템[**[**편집**](https://ko.wikipedia.org/w/index.php?title=%EC%95%8C%ED%8C%8C%EA%B3%A0&action=edit&section=15)**]**

구글의 경쟁자인 [페이스북](https://ko.wikipedia.org/wiki/%ED%8E%98%EC%9D%B4%EC%8A%A4%EB%B6%81)도 그 자신의 바둑 두는 시스템 '다크포레스트'(darkforest)를 제작하고 있으며, 마찬가지로 [머신 러닝](https://ko.wikipedia.org/wiki/%EB%A8%B8%EC%8B%A0_%EB%9F%AC%EB%8B%9D)과 트리 순회를 조합한다.[[21]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-:0-21)[[42]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-facebook-paper-42) 다른 컴퓨터 바둑 프로그램에 대해서는 강력한 상대이지만, 2016년 초인 현재까지 바둑 기사를 이긴 적은 없다.[[43]](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_note-43)

**각주[**[**편집**](https://ko.wikipedia.org/w/index.php?title=%EC%95%8C%ED%8C%8C%EA%B3%A0&action=edit&section=16)**]**

* 1. ↑ [이동: 가](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_ref-googlego_1-0) [나](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_ref-googlego_1-1) [다](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_ref-googlego_1-2) [라](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_ref-googlego_1-3) [마](https://ko.wikipedia.org/wiki/%EC%95%8C%ED%8C%8C%EA%B3%A0#cite_ref-googlego_1-4) [*“Research Blog: AlphaGo: Mastering the ancient game of Go with Machine Learning”*](http://googleresearch.blogspot.com/2016/01/alphago-mastering-ancient-game-of-go.html)*. 《Google Research Blog》. 2016년 1월 27일.*
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