2048 (video game)

2048 is a single-player [sliding tile puzzle](#) video game written by Italian web developer Gabriele Cirulli and published on [GitHub](#). The objective of the game is to slide numbered tiles on a grid to combine them to create a tile with the number 2048; however, one can continue to play the game after reaching the goal, creating tiles with larger numbers. It was originally written in [JavaScript](#) and [CSS](#) over a weekend, and released on 9 March 2014 as [free and open-source software](#) subject to the [MIT License](#). Versions for [iOS](#) and [Android](#) followed in May 2014.

2048 was intended to be an improved version of two other games, both of which were clones of the iOS game *Threes* released a month earlier. Cirulli himself described *2048* as being "conceptually similar" to *Threes*.[2] The release of *2048* resulted in the rapid appearance of many similar games, akin to the flood of *Flappy Bird* variations from 2013. The game received generally positive reviews from critics, with it being described as "viral" and "addictive".

2048	
	2048 App icon
Developer(s)	Gabriele Cirulli
Publisher(s)	Solebon llc
Platform(s)	Web browser, iOS, Nintendo 3DS, Android, Apple TV, KaiOS, Teslatari
Release	Web: 9 March 2014[1]
Genre(s)	Puzzle
Mode(s)	Single-player

Gameplay

2048 is played on a plain 4×4 grid, with numbered tiles that slide when a player moves them using the four arrow keys.[3] Every turn, a new tile randomly appears in an empty spot on the board with a value of either 2 or 4.[4] Tiles slide as far as possible in the chosen direction until they are stopped by either another tile or the edge of the grid. If two tiles of the same number collide while moving, they will merge into a tile with the total value of the two tiles that collided.[5][6] The resulting tile cannot merge with another tile again in the same move. Higher-scoring tiles emit a soft glow;[4] the highest possible tile is 131,072.[7]

If a move causes three consecutive tiles of the same value to slide together, only the two tiles farthest along the direction of motion will combine. If all four spaces in a row or column are filled with tiles of the same value, a move parallel to that row/column will combine the first two and last two.[8] A scoreboard on the upper-right keeps track of the user's score. The user's score starts at zero, and is increased whenever two tiles combine, by the value of the new tile.[4]

The game is won when a tile with a value of 2048 appears on the board. Players can continue beyond that to reach higher scores.[9][10][11] When the player has no legal moves (there are no empty spaces and no adjacent tiles with the same value), the game ends.[2][12]

Strategy

Strategies in 2048 include keeping the highest tiles in a specific corner and to keep that tile in that corner and to fill the specified row with the highest numbers.[13][14]

Development

Nineteen-year-old Gabriele Cirulli created the game in a single weekend as a test to see if he could program a game from scratch.[15] "It was a way to pass the time", he said.[16] He described it as being "conceptually similar" to the recently released iOS game *Threes*,[2][17] and a clone of another game, *1024*.[18] Developed by Veewo Studio,[19] *1024* is itself a clone of *Threes*, with its App Store description once reading "no need to pay for *Threes*".[20] Cirulli's README for *2048* cites another *1024* clone as influence: the homonymous but slightly different in terms of mechanics *2048* by Saming.[21]

Cirulli was surprised when his weekend project received over 4 million visitors in less than a week.[3][22] The game is free to play, Cirulli having said that he was unwilling to make money "from a concept that [he] didn't invent".[23] He released ports for iOS and Android in May 2014.[24]

A completed game. The 2048 tile is in the bottom-right corner.

Adaptations

The simple controls allowed it to be used in a promo video for the Myo gesture control armband,[25] and the availability of the code underneath allowed it to be used as a teaching aid for programming.[26] The second-place winner of a coding contest at Matlab Central Exchange was an AI system that would play *2048* on its own.[27] As the source code is available, many additions to the original game, including a score leaderboard, an undo feature, and improved touchscreen playability have been written by other people. All are available to the public.[3][26]
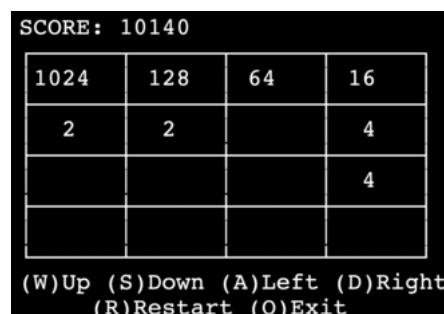

A 2048 variant played on a terminal using the curses library

Spinoffs have been released online and include versions with elements from the Doge meme, *Doctor Who*, *Flappy Bird* and *Tetris*. There has also been a 3D version[28] and versions with bigger or smaller grids.[6] Cirulli sees these spinoffs as "part of the beauty of open source software"[5] and does not object to them "as long as they add new, creative modifications to the game".[29] In 2014, an unofficial clone of the game was published in the iOS app store by Ketchapp, monetized with advertising.[30][31] There has also been a Doctor Who spinoff of the game,[32] as well as one for the Nintendo 3DS, which included a retail release.[33]

Reception

The game has been described by *The Wall Street Journal* as "almost like *Candy Crush* for math

geeks",[5] and *Business Insider* called it "*Threes* on steroids".[1] Caitlin Dewey of *The Washington Post* called it "a nerdy, minimalist, frustrating game",[10] while *The Independent* called it "addictive".[20] The phenomenon of *2048* has been compared to that of *Flappy Bird* by several commentators. Both games' success, and their simplicity, led to the rapid creation of many variants, and both games have been described as "viral" and "very addictive".[34]

James Vincent of *The Independent* labeled *2048* as "a clone of a clone".[20] In April 2014, *Pocket Gamer* reported that 15 new clones of *Threes* were released daily in the App Store.[35] When asked if he was concerned that his situation would end up as stressed as that of Nguyễn Hà Đông, the creator of *Flappy Bird*, Cirulli said that he had "already gone through that phase" on a smaller scale, and that once he had decided against monetizing *2048*, he "stopped feeling awkward."[2]

In response to rampant cloning, the creators of *Threes* published a log of how the game evolved over its 14-month development cycle. They said they had tried and dismissed *2048*'s tile merging variant, because it made the game too easy.[36] In a 2014 *Wired* article, they claimed to have each beaten *2048* on their first play.[36]

AI

The mathematical nature of 2048 has made the game of interest to AI researchers. As of 2022, AI achieved[37] over 95% (likely over 98%, but the measurement has noise) probability of making a 16384 tile, over 75% (likely over 80%) probability of making a 32768, and over 3% probability of making a 65536 (improving over the results in [38] and [39]). Due to randomness and lack of spare room, the optimal probability of making a 65536 tile is expected to be low; this is supported by optimal solutions for constrained boards.[37][40]

2048 AI strategy uses expectimax search up to a certain (variable) depth, plus transposition tables to avoid duplication. Analogously to endgame tablebases, tables are used to estimate success (for building a large enough tile without destroying the configuration) in appropriate positions with many large tiles. A position evaluation function can favor empty squares, having a large number of merge possibilities, placement of larger tiles at the edge, and monotonicity for tile sizes, especially for larger tiles.[41][42] The parameters are optimized by a search for better parameter values; some papers[38][39] used temporal difference reinforcement learning.