

History of video games

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The [Atari VCS](#) was a popular home video game console in the late 1970s and early 1980s. Pictured is the four-switch model from 1980–1982.



An [Atari CX40 joystick](#) controller, with a single button

The **history of video games** goes as far back as the early 1950s, when academic [computer scientists](#) began designing simple games and simulations as part of their research or just for fun. At [M.I.T.](#), in the 1960s, professors and students played games such as 3D tic-tac-toe and Moon Landing. These games were played on computer such as the [IBM 1560](#), and moves were made by means of [punch cards](#). Video gaming did not reach mainstream popularity until the 1970s and 1980s, when video [arcade games](#) and [gaming consoles](#) using [joysticks](#), buttons, and other controllers, along with graphics on [computer screens](#) and [home computer games](#) were introduced to the general public. Since the 1980s, video gaming has become a popular form of entertainment and a part of modern [popular culture](#) in most parts of the world. One of the early games was *[Spacewar!](#)*, which was developed by computer scientists. Early arcade video games developed from 1972 to 1978. During the 1970s, the first generation of home consoles emerged, including the popular game *[Pong](#)* and various "clones". The 1970s was also the era of [mainframe](#) computer games. The golden age of arcade video games was from 1978 to 1982. [Video arcades](#) with large, graphics-decorated coin-operated machines were common at malls and popular, affordable home consoles such as the [Atari 2600](#) and [Intellivision](#) enabled people to play games on their home TVs. During the 1980s, gaming computers, early online gaming and handheld LCD games emerged; this era was affected by the video game crash of 1983. From 1976 to 1992, the second generation of video consoles emerged.

The third generation of consoles, which were 8-bit units, emerged from 1983 to 1995. The fourth generation of consoles, which were 16-bit models, emerged from 1987 to 1999. The 1990s saw the resurgence and decline of arcades, the transition to 3D video games, improved handheld games, and PC gaming. The fifth generation of consoles, which were 32 and 64-bit units, was from 1993 to 2006. During this era, mobile phone gaming emerged. During the 2000s, the sixth generation of consoles emerged (1998–2013). During this period, online gaming and mobile games became major aspects of gaming culture. The seventh generation of consoles was from 2005 to 2012. This era was marked by huge

development budgets for some games, with some having cinematic graphics; the launch of the top-selling [Wii](#) console, in which the user could control the game actions with real-life movement of the controller; the rise of casual PC games marketed to non-gamers; and the emergence of [cloud computing](#) in video games.

In 2013, the eighth generation of consoles emerged, including [Nintendo's Wii U](#) and [Nintendo 3DS](#), [Microsoft's Xbox One](#), and [Sony's PlayStation 4](#) and [PlayStation Vita](#). PC gaming has been holding a large market share in Asia and Europe for decades and continues to grow due to [digital distribution](#). Since the development and widespread consumer use of [smartphones](#), [mobile gaming](#) has been a driving factor for games, as they can reach people formerly uninterested in gaming, and those unable to afford or support dedicated hardware, such as video game consoles.

Early history (1948–1972)

Defining the video game

The term *video game* has evolved over the decades from a purely technical definition to a general concept defining a new class of interactive entertainment. Technically, for a product to be a video game, there must be a video signal transmitted to a [cathode ray tube](#) (CRT) that creates a rasterized image on a screen.^[1] This definition precluded early computer games that outputted results to a printer or [teletype](#) rather than a display, any game rendered on a [vector-scan](#) monitor, any game played on a modern high definition display, and most handheld game systems.^[2] From a technical standpoint, these were more properly called "electronic games" or "computer games."^[3]

Today, however, the term "video game" has completely shed its purely technical definition and encompasses a wider range of technology. While still rather ill-defined, the term "video game" now generally encompasses any game played on hardware built with electronic logic circuits that incorporates an element of interactivity and outputs the results of the player's actions to a display.^[4] Going by this broader definition, the first video games appeared in the early 1950s and were tied largely to research projects at universities and large corporations.

Origins of electronic computer games

The first electronic digital computers, [Colossus](#) and [ENIAC](#), were built during [World War II](#) to aid the [Allied](#) war effort against the [Axis powers](#).^[5] Shortly after the war, the promulgation of the first [stored program architectures](#) at the [University of Manchester \(Manchester Mark 1\)](#), [Cambridge University \(EDSAC\)](#), the [University of Pennsylvania \(EDVAC\)](#), and [Princeton University \(IAS machine\)](#) allowed computers to be easily reprogrammed to undertake a variety of tasks, which facilitated commercializing computers in the early 1950s by companies like [Remington Rand](#), [Ferranti](#), and [IBM](#).^[6] This in turn promoted the adoption of computers by universities, government organizations, and large corporations as the decade progressed.^[7] It was in this environment that the first video games were born.

The computer games of the 1950s can generally be divided into three categories: training and instructional programs, research programs in fields such as [artificial intelligence](#), and demonstration programs intended to impress or entertain the public. Because these games were largely developed on unique hardware in a time when porting between systems was difficult and were often dismantled or discarded after serving their limited purposes, they did not generally influence further developments in the industry.^[8] For the same reason, it is impossible to be certain who developed the first computer game or who originally modeled many of the games or play mechanics introduced during the decade, as there are likely several games from this period that were never publicized and are thus unknown today.^[8]

The earliest known [chess](#) computer program was developed by [Alan Turing](#) and [David Champernowne](#) called *Turochamp*, which was completed in 1950 but not actually implemented by them on a computer.^[9] The earliest known idea for a fully electronic game is a "Cathode-Ray Tube Amusement Device" in US patent #2,455,992.^[10]

The earliest known electronic computer games actually implemented were two custom built machines called *Bertie the Brain* and *Nimrod*, which played [tic-tac-toe](#) and the game of [Nim](#), respectively. *Bertie the Brain*, designed and built by [Josef Kates](#) at Rogers Majestic, was displayed at the [Canadian National Exhibition](#) in 1950,^[11] while *Nimrod*, conceived by [John Bennett](#) at Ferranti and built by Raymond Stuart-

Williams, was displayed at the [Festival of Britain](#) and the Berlin Industrial Show in 1951.^[12] Neither game incorporated a [cathode ray tube](#) (CRT) display.^{[13][14]} Before these, automated games like the simple chess simulator [El Ajedrecista](#) (1914)^{[15][16][17]} and Nimrod's predecessor [Nimatron](#)(1940)^{[18][19]} had been created as [electro-mechanical](#) devices.

The first games known to incorporate a monitor were two research projects completed in 1952, a [checkers](#) program by [Christopher Strachey](#) on the [Ferranti Mark 1](#)^[20] and a tic-tac-toe program called [OXO](#) by [Alexander Douglas](#) on the EDSAC.^[21] Both of these programs used a relatively static display to track the current state of the game board. The first known game incorporating graphics that updated in real time was a [billiards](#) game programmed by William Brown and Ted Lewis specifically for a demonstration of the MIDSAC computer at the [University of Michigan](#) in 1954.^[8]



Tennis for Two – Modern recreation

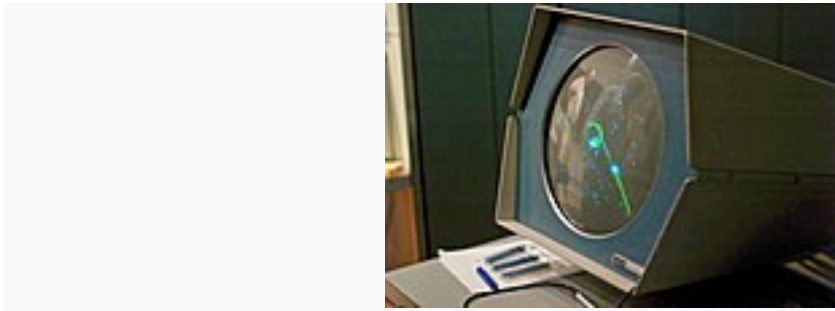
Perhaps the first game created solely for entertainment rather than to demonstrate the power of some technology, train personnel, or aid in research was [Tennis for Two](#), designed by [William Higinbotham](#) and built by Robert Dvorak at the [Brookhaven National Laboratory](#) in 1958. Designed to entertain the general public at Brookhaven's annual series of open houses, the game was deployed on an [analog computer](#) with graphics displayed on an [oscilloscope](#) and was dismantled in 1959. Higinbotham never considered adapting the successful game into a commercial product, which would have been impractical with the technology of the time. Ultimately, the widespread adoption of computers to play games would have to wait for the machines to spread from serious academics to their students on U.S. college campuses.

Spacewar!

The [mainframe computers](#) of the 1950s were generally [batch processing](#) machines of limited speed and memory. This made them generally unsuited for games. Furthermore, they were costly and relatively scarce commodities, so computer time was a precious resource that could not be wasted on frivolous pursuits like entertainment. At the [Lincoln Laboratory](#) at the [Massachusetts Institute of Technology](#) (MIT), however, a team led by [Jay Forrester](#) developed a computer called [Whirlwind](#) in the early 1950s that processed commands in [real time](#) and incorporated a faster and more reliable form of [random access memory](#) (RAM) based around magnetic cores. Based on this work, two employees at the lab named [Ken Olsen](#) and [Wes Clark](#) developed a prototype real time computer called the [TX-0](#) that incorporated the recently invented [transistor](#), which ultimately allowed the size and cost of computers to be significantly reduced. Olsen subsequently established the [Digital Equipment Corporation](#) (DEC) with [Harlan Anderson](#) in 1957 and developed a commercial update of the TX-0 called the [PDP-1](#).

Lincoln Laboratory donated the TX-0 to MIT in 1958. As the computer operated in real time and thus allowed for interactive programming, MIT allowed students to program the computer to conduct their own research, perhaps the first time that university students were allowed to directly access a computer for their own work. Further, the university decided to allow students to set the computer to tasks outside the bounds of classwork or faculty research during periods of time no one was signed up to do official work. This resulted in a community of undergraduate students led by Bob Saunders, [Peter Samson](#), and [Alan Kotok](#), many of them affiliated with the [Tech Model Railroad Club](#), conducting their own experiments on the computer. In 1961, MIT received one of the first PDP-1 computers, which incorporated a relatively sophisticated point-plotting monitor. MIT provided a similar level of access to the computer for students as

it did for the TX-0, resulting in the creation of the first (relatively) widespread, and thus influential, computer game, [Spacewar!](#)



[Spacewar!](#) is credited as the first widely available and influential computer game.

Conceived by [Steve Russell](#), Martin Graetz, and Wayne Wiitanen in 1961 and programmed primarily by Russell, Saunders, Graetz, Samson, and Dan Edwards in the first half of 1962, *Spacewar!* was inspired by the science fiction stories of [E. E. Smith](#) and depicted a duel between two spaceships, each controlled by a player using a custom built control box. Immensely popular among students at MIT, *Spacewar!* spread to the [West Coast](#) later in the year when Russell took a job at the [Stanford Artificial Intelligence Laboratory](#) (SAIL), where it enjoyed similar success. The program subsequently migrated to other locations around the country through the efforts of both former MIT students and DEC itself, more so after [cathode ray tube](#) (CRT) terminals started becoming more common at the end of the 1960s.

As computing resources continued to expand over the remainder of the decade through the adoption of time sharing and the development of simpler high-level programming languages like [BASIC](#), an increasing number of college students began programming and sharing simple sports, puzzle, card, logic, and board games as the decade progressed. These creations remained trapped in computer labs for the remainder of the decade, however, because even though some adherents of *Spacewar!* had begun to sense the commercial possibilities of computer games, they could only run on hardware costing hundreds of thousands of dollars. As computers and their components continued to fall in price, however, the dream of a commercial video game finally became attainable at the start of the 1970s.

The commercialization of video games

By 1970, the introduction of [medium scale integration](#) (MSI) [transistor-transistor logic](#) (TTL) circuits combining multiple transistors on a single [microchip](#) had resulted in another significant reduction in the cost of computing and ushered in a new wave of minicomputers costing under \$10,000. While still far too costly for the home, these advances lowered the cost of computing enough that it could be seriously considered for the [coin-operated games](#) industry, which at the time was experiencing its own technological renaissance as large electro-mechanical target shooting and driving games like [Sega Enterprises's Periscope](#) (1967) and [Chicago Coin's Speedway](#) (1969) pioneered the adoption of elaborate visual displays and electronic sound effects in the [amusement arcade](#). Consequently, when a recent engineering graduate from Utah with experience running coin-operated equipment named [Nolan Bushnell](#) first saw *Spacewar!* at SAIL in late 1969 or early 1970, he resolved to build a coin-operated version for public consumption. Enlisting the aid of an older and more experienced engineer named [Ted Dabney](#), Bushnell built a variant of the game called [Computer Space](#) in which a single player-controlled spaceship duelled two hardware-controlled flying saucers. Released in late November or early December 1971 through [Nutting Associates](#), the game failed to have much impact in the coin-operated marketplace.



The [Magnavox Odyssey](#), the first home console

Meanwhile, [Ralph Baer](#), an engineer with a degree in television engineering working for defense contractor [Sanders Associates](#), had been working since 1966 on a video game system that could be plugged into a standard television set. Working primarily with technician Bill Harrison, who built most of the actual hardware, Baer developed a series of prototype systems between 1966 and 1969 based around [diode-transistor logic](#) (DTL) circuits that sent a video signal to a television set to generate spots on the screen that could be controlled by the players. Originally able to generate only two spots, the system was modified in November 1967 at the suggestion of engineer Bill Rusch to generate a third spot for use in a table tennis game in which each player controlled a single spot that served as a paddle and volleyed the third spot, which acted as a ball. In 1971, Sanders concluded a licensing agreement with television company [Magnavox](#) to release the system, which reached the market in September 1972 as the [Magnavox Odyssey](#). The system launched with a dozen games included in the box, four more sold with a separate [light gun](#), and six games sold separately, most of which were chase, racing, target shooting, or sports games. These games were activated using plug-in circuit cards that defined how the spots generated by the hardware would behave. Due to the limited abilities of the system, which could only render three spots and a line, most of the graphic and gameplay elements were actually defined by plastic overlays attached to the TV set along with accessories like boards, cards, and dice. Like *Computer Space* the Odyssey only performed modestly and failed to jump start a new industry. However, the system did directly influence the birth of a vibrant video arcade game industry after Ralph Baer's design ingenuity intersected Nolan Bushnell's entrepreneurial ambition.

A new industry

Early arcade video games (1972–1978)



[Pong](#) was the first arcade game to ever receive universal acclaim.

In 1972, [Nolan Bushnell](#) and [Ted Dabney](#) decided to strike out on their own and incorporated their preexisting partnership as [Atari](#). After seeing a demonstration of the Magnavox Odyssey ahead of its release, Bushnell charged new hire [Allan Alcorn](#) to create a version of that system's [table tennis](#) game as a practice project to familiarize himself with video game design. Alcorn's version ended up being so fun that Atari decided to release it as [Pong](#). Available in limited quantities in late 1972, *Pong* began reaching the market in quantity in March 1973, after which it ignited a new craze for ball-and-paddle video games in the [coin-operated amusement](#) industry. The success of *Pong* did not result in the displacement of traditional arcade amusements like [pinball](#), but did lay the foundation for a successful video arcade game industry. Roughly 70,000 video games, mostly ball-and-paddle variants, were sold in 1973 by a combination of recent startups like Atari, Ramtek, and [Allied Leisure](#) and established Chicago firms like [Williams](#), Chicago Coin, and the [Midway](#) subsidiary of [Bally Manufacturing](#).

The video arcade game market remained in a state of flux for the remainder of the decade. The ball-and-paddle market collapsed in 1974 due to market saturation, which led to a significant drop in video game sales. Smaller manufacturers attempted to compensate by creating "cocktail table" cabinets for sale to non-traditional venues like higher class restaurants and lounges, but this market failed to fully develop. Larger companies like Atari and Midway turned to new genres to remain successful, especially racing games, one-on-one dueling games, and target shooting games. Early hits in these genres included [Gran Trak 10](#) (1974) and [Tank](#) (1974) from Atari, and [Wheels](#) (1975), [Gun Fight](#), (1975) and [Sea Wolf](#) (1976) from

Midway. *Wheels* and *Gun Fight* were licensed versions of *Speed Race* and *Western Gun* developed by the [Taito Trading Company](#) of Japan, marking the start of Japanese video game penetration into the United States. *Gun Fight* was also one of the first arcade games to incorporate a [microprocessor](#), starting a shift away from video arcade games engineered using dedicated TTL hardware to video games programmed in software.

The video game was one of several concepts that helped to reform the image of the arcade as a seedy hangout for delinquents. This in turn aided the growth of arcades in suburban shopping malls. The principle pioneer of the shopping mall arcade was Jules Millman, who established an arcade in a shopping mall in Harvey, Illinois, in 1969. By banning eating, drinking, and smoking, and maintaining a full staff at all times to keep an eye on the facilities, Millman created a safe environment where parents could feel safe leaving their older children while browsing other stores in the mall. Millman founded American Amusements to establish more shopping mall arcades, which was purchased by Bally in 1974 and renamed [Aladdin's Castle](#). Other entrepreneur's imitated Millman's format, and arcades became a mainstay of the shopping mall by the end of the decade.

The emergence of solid state pinball in the late 1970s, in which electro-mechanical technologies like relays were replaced by the newly emerging microprocessor, temporarily stole the limelight from video games, which once again entered a period of decline in 1977 and 1978. While individual games like Atari's *Breakout* (1976) and [Cinematronics'](#) *Space Wars* (1978) sold in large numbers during this period, overall profitability began to lag. The market surged once again, however, after the introduction of the Taito game *Space Invaders* by Midway in 1979.

First generation of home consoles and the *Pong* clones (1972–1978)



Magnavox's 1975 Odyssey game console

The Magnavox Odyssey never caught on with the public, due largely to the limited functionality of its primitive technology. By the middle of the 1970s, however, the ball-and-paddle craze in the arcade had ignited public interest in video games and continuing advances in integrated circuits had resulted in [large-scale integration](#) (LSI) microchips cheap enough to be incorporated into a consumer product. In 1975, Magnavox reduced the part count of the Odyssey using a three-chip set created by Texas Instruments and released two new systems that only played ball-and-paddle games, the [Odyssey 100](#) and [Odyssey 200](#). Atari, meanwhile, entered the consumer market that same year with the single-chip [Home Pong](#) system designed by Harold Lee. The next year, General Instrument released a "Pong-on-a-chip" LSI and made it available at a low price to any interested company. Toy company [Coleco](#) Industries used this chip to create the million-selling [Telstar](#) console model series (1976–77), while dozens of other companies released models as well. Overall, sales of dedicated ball-and-paddle systems in the U.S. grew from 350,000 in 1975 to a peak of 5–6 million in 1977. A similar boom hit the United Kingdom and other parts of Europe, with much of the market supplied by clone manufacturers in Hong Kong.

After 1977, the dedicated console market in the United States collapsed. A new wave of programmable systems hit the market starting with the [Fairchild Channel F](#) in 1976 that offered the possibility of purchasing and playing a wider variety of games stored on cartridges containing mask ROM that could be plugged directly into the CPU of the console. As older model dedicated consoles were heavily discounted and consumers with more purchasing power transitioned to the new programmable systems, newer dedicated systems with more advanced features like [Video Pinball](#) from Atari and the [Odyssey 4000](#) were squeezed out by their lower priced predecessors and their more sophisticated programmable replacements. This caused a brief dip in the market and the exit of industry leader Coleco, which failed to transition to programmable hardware. [Fairchild](#) remained in the new programmable market alongside Atari and Magnavox, which released the [VCS](#) (1977) and [Odyssey²](#) (1978) respectively.

Mainframe computer games (1971–1979)

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.RUN ADV11

WELCOME TO ADVENTURE!! WOULD YOU LIKE INSTRUCTIONS?

YES
SOMEWHERE NEARBY IS COLOSSAL CAVE. WHERE OTHERS HAVE FOUND
FORTUNES IN TREASURE AND GOLD. THOUGH IT IS RUMORED
THAT SOME WHO ENTER ARE NEVER SEEN AGAIN. MAGIC IS SAID
TO WORK IN THE CAVE. I WILL BE YOUR EYES AND HANDS. DIRECT
ME WITH COMMANDS OF 1 OR 2 WORDS.
(ERRORS, SUGGESTIONS, COMPLAINTS TO CROWTHER)
(IF STUCK TYPE HELP FOR SOME HINTS)

YOU ARE STANDING AT THE END OF A ROAD BEFORE A SMALL BRICK
BUILDING . AROUND YOU IS A FOREST. A SMALL
STREAM FLOWS OUT OF THE BUILDING AND DOWN A GULLY.

GO IN
YOU ARE INSIDE A BUILDING, A WELL HOUSE FOR A LARGE SPRING.

THERE ARE SOME KEYS ON THE GROUND HERE.

THERE IS A SHINY BRASS LAMP NEARBY.

THERE IS FOOD HERE.

THERE IS A BOTTLE OF WATER HERE.
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The on-screen instructions from [Will Crowther's](#) 1976 game [Colossal Cave Adventure](#).

In the 1960s, a number of computer games were created for mainframe and [minicomputer](#) systems, but these failed to achieve wide distribution due to the continuing scarcity of computer resources, a lack of sufficiently trained programmers interested in crafting entertainment products, and the difficulty in transferring programs between computers in different geographic areas. By the end of the 1970s, however, the situation had changed drastically. The [BASIC](#) and [C](#) high-level [programming languages](#) were widely adopted during the decade, which were more accessible than earlier more technical languages such as [FORTRAN](#) and [COBOL](#), opening up computer game creation to a larger base of users. With the advent of [time-sharing](#), which allowed the resources of a single mainframe to be parceled out among multiple users connected to the machine by terminals, computer access was no longer limited to a handful of individuals at an institution, creating more opportunities for students to create their own games. Furthermore, the widespread adoption of the [PDP-10](#), released by [Digital Equipment Corporation](#) (DEC) in 1966, and the portable [UNIX operating system](#), developed at [Bell Labs](#) in 1971 and released generally in 1973, created common programming environments across the country that reduced the difficulty of sharing programs between institutions. Finally, the founding of the first magazines dedicated to computing like [Creative Computing](#) (1974), the publication of the earliest program compilation books like *101 BASIC Computer Games* (1973), and the spread of wide-area networks such as the [ARPANET](#) allowed programs to be shared more easily across great distances. As a result, many of the mainframe games created by college students in the 1970s influenced subsequent developments in the video game industry in ways that, *Spacewar!* aside, the games of the 1960s did not.

In the arcade and on home consoles, fast-paced action and [real-time](#) gameplay were the norm in genres like [racing](#) and [target shooting](#). On the mainframe, however, such games were generally not possible due both to the lack of adequate displays (many computer terminals continued to rely on [teletypes](#) rather than monitors well into the 1970s and even most CRT terminals could only render character-based graphics) and insufficient processing power and memory to update game elements in real time. While 1970s mainframes were more powerful than arcade and console hardware of the period, the need to parcel out computing resources to dozens of simultaneous users via time-sharing significantly hampered their abilities. Thus, programmers of mainframe games focused on strategy and puzzle-solving mechanics over pure action. Notable games of the period include the tactical combat game *Star Trek* (1971) by [Mike Mayfield](#), the [hide-and-peek](#) game *Hunt the Wumpus* (1972) by [Gregory Yob](#), and the strategic war game *Empire* (1977) by [Walter Bright](#). Perhaps the most significant game of the period was [Colossal Cave Adventure](#) (or simply *Adventure*), created in 1976 by [Will Crowther](#) by combining his passion for caving with concepts from the newly released tabletop role-playing game (RPG) [Dungeons and Dragons](#) (D&D). Expanded by [Don Woods](#) in 1977 with an emphasis on the high fantasy of [J.R.R.](#)

[Tolkien](#), *Adventure* established a new genre based around exploration and inventory-based puzzle solving that made the transition to personal computers in the late 1970s.

While most games were created on hardware of limited graphic ability, one computer able to host more impressive games was the [PLATO system](#) developed at the [University of Illinois](#). Intended as an educational computer, the system connected hundreds of users all over the United States via remote terminals that featured high-quality [plasma displays](#) and allowed users to interact with each other in real time. This allowed the system to host an impressive array of graphical and/or multiplayer games, including some of the earliest known computer RPGs, which were primarily derived, like *Adventure*, from *D&D*, but unlike that game placed a greater emphasis on combat and character progression than puzzle solving. Starting with top-down dungeon crawls like *The Dungeon* (1975) and *The Game of Dungeons* (1975), more commonly referred to today by their filenames, [pedit5](#) and [dnd](#), PLATO RPGs soon transitioned to a first-person perspective with games like [Moria](#) (1975), [Oubliette](#) (1977), and [Avatar](#) (1979), which often allowed multiple players to join forces to battle monsters and complete quests together. Like *Adventure*, these games ultimately inspired some of the earliest personal computer games.

Golden age

Golden age of arcade video games (1978–1982)



[Space Invaders](#) was a popular game during the golden age. The game introduced many elements which would become standard in video games.

By 1978, video games were well established in the U.S. coin-operated amusement industry, but their popularity was secondary to the industry stalwarts of pool and pinball. That changed with the introduction of a new game developed in Japan. While video games had been introduced to Japan soon after hitting the United States, the Japanese arcade industry had remained primarily focused on electro-mechanical driving and shooting games and a type of slot machine called the "medal game" that accepted and paid out in medals instead of currency so as not to be classified as a gambling game. In 1977, the arrival of *Breakout*, distributed locally by the [Nakamura Manufacturing Company](#), and the advent of table-top game units, pioneered by Taito, created new demand for video games in snack bars and tea houses. Taito designer [Tomohiro Nishikado](#) decided to build on the popularity of *Breakout* by replacing the paddle in the game with a gun battery and the bricks in the game with rows of aliens that descended line-by-line while firing at the player. Taito released this game in 1978 as *Space Invaders*.



Games such as [Galaxian](#), [Galaga](#) and [Donkey Kong](#) were popular in arcades during the early 1980s.

Space Invaders introduced or popularized several important concepts in arcade video games, including play regulated by [lives](#) instead of a timer or set score, gaining [extra lives](#) through accumulating points, and the tracking of the [high score](#) achieved on the machine. It was also the first game to confront the player with waves of targets that shot back at the player and the first to include background music during game play, albeit a simple four-note loop. With its intense game play and competitive scoring features, *Space Invaders* became a national phenomenon as over 200,000 invader games—counting clones and knockoffs—entered Japanese game centers by the middle of 1979. While not quite as popular in the United States, *Space Invaders* became the biggest hit the industry had seen since the [Great Depression](#) as Midway, serving as the North American manufacturer, moved over 60,000 cabinets. The one-two punch of *Space Invaders* and the Atari game *Asteroids* (1979), which moved 70,000 units and popularized the recording of multiple high scores in a table, resulted in video arcade games completely displacing pinball and other amusements to become the central attraction of not just the shopping mall arcade, but also a variety of street locations from convenience stores to bowling alleys to pizza parlors. Many of the best-selling games of 1980 and 1981 such as [Galaxian](#) (1979), [Defender](#) (1980), [Missile Command](#) (1980), [Tempest](#) (1981), and [Galaga](#) (1981) focused on shooting mechanics and achieving high scores. Starting with [Pac Man](#) in 1980, which sold 96,000 units in the United States, a new wave of games appeared that focused on identifiable characters and alternate mechanics such as navigating a maze or traversing a series of platforms. Aside from *Pac Man* and its sequel, [Ms. Pac-Man](#) (1982), the most popular games in this vein were [Donkey Kong](#) (1981) and [Q*bert](#) (1982).

According to trade publication *Vending Times*, revenues generated by coin-operated video games on location in the United States jumped from \$308 million in 1978 to \$968 million in 1979 to \$2.8 billion in 1980. As *Pac Man* ignited an even larger video game craze and attracted more female players to arcades, revenues jumped again to \$4.9 billion in 1981. According to trade publication *Play Meter*, by July 1982, total coin-op collections peaked at \$8.9 billion, of which \$7.7 billion came from video games. Meanwhile, the number of arcades—defined as any location with ten or more games—more than doubled between July 1981 and July 1983 from over 10,000 to just over 25,000. These figures made arcade games the most popular entertainment medium in the country, far surpassing both pop music (at \$4 billion in sales per year) and Hollywood films (\$3 billion).^[22]

Second generation consoles (1976–1982)



[Intellivision](#) was a home console system introduced in 1979.

After the collapse of the dedicated console market in 1978, focus in the home shifted to the new programmable systems, in which game data was stored on ROM-based cartridges. Fairchild semiconductor struck first in this market with the Channel F, but after losing millions in the digital watch business, the company took a conservative approach to the programmable console market and kept production runs of the system low. As a result, by the end of 1977, Fairchild had only sold about 250,000 systems. Atari followed Fairchild into the market in 1977 and sold between 340,000 and 400,000 systems that year. Magnavox joined the programmable market in 1978 with the Odyssey², while toy company Mattel released the Intellivision in 1979, which featured graphics superior to any of its competitors.

After both Atari and Fairchild made a strong showing in 1977, the market hit a difficult patch in 1978 when retailers resisted building inventory, believing that the newly emerging electronic handheld market would displace video games. Atari, for example, manufactured 800,000 systems, but proved unable to sell more than 500,000 to retail. This helped precipitate a crisis at the company that saw co-founder and chairman Nolan Bushnell and president Joe Keenan forced out by Atari's parent company, Warner Communications, which had purchased Atari in 1976 largely on the potential of the VCS. Ultimately, home video games did well in the 1978 holiday season, and retailers proved more amenable to stocking them again in 1979. New Atari CEO Ray Kassar subsequently harnessed his company's leftover stock to help transform video game consoles into a year-round product rather than something just purchased by retailers for sale during the holiday season.

The real breakthrough for the home video game market occurred in 1980 when Atari released a conversion of the popular *Space Invaders* game for the VCS, which was licensed from Taito. Buoyed by the success of the game, Atari's consumer sales almost doubled from \$119 million to nearly \$204 million in 1980 and then exploded to over \$841 million in 1981, while sales across the entire video game industry in the United States rose from \$185.7 million in 1979 to just over \$1 billion in 1981. Through a combination of conversions of its own arcade games like *Missile Command* and *Asteroids* and licensed conversions like *Defender*, Atari took a commanding lead in the industry, with an estimated 65% market share of the worldwide industry by dollar volume by 1981. Mattel settled into second place with roughly 15%-20% of the market, while Magnavox ran a distant third, and Fairchild exited the market entirely in 1979.

In the early days of the programmable market, all of the games for a given system were developed by the firm that released the console. That changed in 1979 when four Atari programmers, seeking greater recognition and financial reward for their contributions, struck out on their own to form Activision, the first third-party developer. The company went on to develop a string of hits including *Kaboom!* (1981), *River Raid* (1982), and *Pitfall!* (1982), recognized as one of the foundational games of the scrolling platformer genre. In 1981, another group of Atari employees joined with ex-Mattel staff to form Imagic and experienced success with games like *Demon Attack* (1982) and *Atlantis* (1982).

In 1982, Atari released a more advanced console based on its 8-bit computer line, the Atari 5200, which failed to perform as well as its predecessor. That same year, Coleco returned to the video game market with a new console, the ColecoVision, that featured near-arcade-quality graphics and shipped with a port of the popular arcade game *Donkey Kong*. Coleco sold out its entire run of 550,000 units in the 1982 holiday season as overall U.S. video game sales reached \$2.1 billion, which represented 31% of the dollar volume of the entire toy industry. Ultimately, however, the rapid growth of the home console market could not be sustained, and the industry soon faced a serious downturn that would nearly wipe it out during the [video game crash of 1983](#).

Early home computer games (1976–1982)

While the fruit of retail development in early video games appeared mainly in video arcades and home consoles, [home computers](#) began appearing in the late 1970s and were rapidly evolving in the 1980s, allowing their owners to program simple games. [Hobbyist](#) groups for the new computers soon formed and [PC game](#) software followed. Soon many of these games—at first clones of mainframe classics such as *Star Trek*, and then later ports or clones of popular arcade games such as *Space Invaders*, *Frogger*,^[23] *Pac-Man* (see [Pac-Man clones](#))^[24] and *Donkey Kong*^[25]—were being distributed through a variety of channels, such as printing the game's [source code](#) in books (such as David Ahl's *BASIC Computer Games*), magazines (*Creative Computing*), and newsletters, which allowed users to [type in the code for themselves](#). Early game designers like Crowther, Daglow and Yob found the computer code for their games—which they had never thought to copyright—published in books and magazines, with their

names removed from the listings. Early home computers from [Apple](#), [Commodore](#), [Tandy](#) and others had many games that people typed in.

Games were also distributed by the physical mailing and selling of floppy disks, cassette tapes, and [ROM](#) cartridges. Soon a small [cottage industry](#) was formed, with amateur programmers selling disks in plastic bags put on the shelves of local shops or sent through the mail. [Richard Garriott](#) distributed several copies of his 1980 [role-playing video game](#) *Akalabeth: World of Doom* in plastic bags before the game was published.

1980s

The video games industry experienced its first major growing pains in the early 1980s as [publishing houses](#) appeared, with many businesses surviving 20+ years, such as [Electronic Arts](#)—alongside [fly-by-night](#) operations that cheated the games' developers. While some early 1980s games were simple clones of existing arcade titles, the relatively low publishing costs for personal computer games allowed for bold, unique games.

Gaming computers

Following the success of the [Apple II](#) and [Commodore PET](#) in the late 1970s, a series of cheaper and incompatible rivals emerged in the early 1980s. This second batch included the [Commodore VIC-20](#) and [64](#); Sinclair [ZX80](#), [ZX81](#) and [ZX Spectrum](#); [NEC PC-8000](#), [PC-6001](#), [PC-88](#) and [PC-98](#); [Sharp X1](#) and [X68000](#); and [Atari 8-bit family](#), [BBC Micro](#), [Acorn Electron](#), [Amstrad CPC](#), and [MSX](#) series. These rivals helped to catalyze both the home computer and game markets, by raising awareness of computing and gaming through their competing advertising campaigns.

The Sinclair, Acorn and Amstrad offerings were generally only known in Europe and Africa, the NEC and Sharp offerings were generally only known in Asia, and the MSX had a base in South America, Europe, Middle East and Asia, while the US-based Apple, Commodore and Atari offerings were sold in both the US and Europe.

Games dominated home computers' software libraries. A 1984 compendium of reviews of Atari 8-bit software used 198 pages for games compared to 167 for all others.^[26] By that year the computer gaming market took over from the console market following the crash of that year; computers offered equal gaming ability and, since their simple design allowed games to take complete command of the hardware after power-on, they were nearly as simple to start playing with as consoles.



The Commodore 64 system

The [Commodore 64](#) was released to the public in August 1982. It found initial success because it was marketed and priced aggressively. It had a [BASIC](#) programming environment, and advanced graphic and sound abilities for its time, similar to the [ColecoVision](#) console. It also used the same game controller ports popularized by the Atari 2600, allowing gamers to use their old joysticks with the system. It became the most popular home computer of its day in the United States and, internationally, the best-selling single computer model of all time.

At around the same time, the Sinclair [ZX Spectrum](#) was released in the United Kingdom and quickly became the most popular home computer in many areas of Western Europe—and later the [Eastern Bloc](#)—due to the ease with which clones could be produced.^{[27][28][29]} A number of prominent video game developers emerged in Britain in the late 1970s and early 1980s.^[30]

In 2008 [Sid Meier](#) listed the IBM PC as one of the three most important innovations in the history of video games.^[31] The [IBM PC compatible](#) platform became a technically competitive gaming platform with IBM's [PC/AT](#) in 1984. The primitive [CGA](#) graphics of prior models, with only 4-color 320×200 pixel graphics (or, using special programming, 16-color 160×100 graphics^[32]) had limited the PC's appeal to the business segment, as its graphics failed to compete with the C64 or Apple II. The new 64-color^[33] [Enhanced Graphics Adapter](#) (EGA) display standard allowed its graphics to approach the quality seen in popular home computers like the Commodore 64. However, the sound abilities of the AT were still limited to the [PC speaker](#), which was substandard compared to the built-in [sound chips](#) used in many home computers. Also, the relatively high cost of the PC compatible systems severely limited their popularity in gaming.

The Apple [Macintosh](#) also arrived at this time. It lacked the color abilities of the earlier [Apple II](#), instead preferring a much higher pixel resolution, but the operating system support for the [graphical user interface](#) (GUI) attracted developers of some games (e.g. [Lode Runner](#)) even before color returned in 1987 with the Mac II.

The arrival of the [Atari ST](#) and Commodore [Amiga](#) in 1985 was the start of a new era of 16-bit machines. For many users they were too costly until later on in the decade, at which point advances in the IBM PC's open platform had caused the [IBM PC compatibles](#) to become comparably powerful at a lower cost than their competitors. The [VGA](#) standard developed for the new [IBM Personal System/2](#) (PS/2) line in 1987 gave the PC the potential for 256-color graphics. This was a big jump ahead of most 8-bit home computers but still lagged behind platforms with built-in sound and graphics hardware like the Amiga. This caused an odd trend around '89–91 toward developing for a seemingly inferior machine. Thus while both the ST and Amiga were host to many technically excellent games, their time of prominence was shorter than that of the 8-bit machines, which saw new ports well into the 1980s and even the 1990s.



The [Yamaha YM3812](#) sound chip

Dedicated [sound cards](#) started to address the issue of poor sound abilities in [IBM PC compatibles](#) in the late 1980s. [Ad Lib](#) set an early de facto standard for sound cards in 1987, with its card based on the [Yamaha YM3812](#) sound chip. This lasted until the introduction of [Creative Labs' Sound Blaster](#) in 1989, which took the chip and added new features while remaining compatible with [Ad Lib](#) cards, and creating a new de facto standard. However, many games still supported these and rarer things like the [Roland MT-32](#) and [Disney Sound Source](#) into the early 1990s. The initial high cost of sound cards meant they did not find widespread use until the 1990s.

[Shareware](#) gaming first appeared in the mid-1980s, but its big successes came in the 1990s.^[34]

Early online gaming

[Dial-up bulletin board systems](#) were popular in the 1980s, and sometimes used for online game playing. The earliest such systems were in the late 1970s and early 1980s and had a crude plain-text interface. Later systems made use of terminal-control codes (the so-called [ANSI art](#), which included the use of IBM-PC-specific characters not part of an [American National Standards Institute](#) (ANSI) standard) to get a [pseudo-graphical](#) interface. Some BBSs offered access to various games which were playable through such an interface, ranging from text adventures to gambling games like [blackjack](#) (generally played for "points" rather than real money). On some multiuser BBSs (where more than one person could be online at once), there were games allowing users to interact with one another.

[SuperSet Software](#) created [Snipes](#), a text-mode networked computer game in 1983 to test a new [IBM Personal Computer](#)-based computer network and demonstrate its abilities. *Snipes* is officially credited as

being the original inspiration for [NetWare](#). It is believed to be the first network game ever written for a commercial personal computer and is recognized alongside 1974 game [Maze War](#) (a networked multiplayer maze game for several research machines) and [Spasim](#) (a 3D multiplayer space simulation for time shared [mainframes](#)) as the precursor to multiplayer games such as 1987's [MIDI Maze](#), and [Doom](#) in 1993. In 1995 iDoom (later [Kali.net](#)) was created for games that only allowed local network play to connect over the internet. Other services such as [Kahn](#), [TEN](#), [Mplayer](#), and [Heat.net](#) soon followed after. These services ultimately became obsolete when game producers began including their own online software such as [Battle.net](#), [WON](#) and later [Steam](#).

The first user interfaces were plain-text—similar to BBSs— but they operated on large mainframe computers, permitting larger numbers of users to be online at once. By the end of the decade, inline services had fully graphical environments using software specific to each personal computer platform. Popular text-based services included [CompuServe](#), [The Source](#), and [GEnie](#), while platform-specific graphical services included [PlayNET](#) and [Quantum Link](#) for the [Commodore 64](#), [AppleLink](#) for the [Apple II](#) and [Macintosh](#), and [PC Link](#) for the [IBM PC](#)—all of which were run by the company which eventually became [America Online](#)—and a competing service, [Prodigy](#). Interactive games were a feature of these services, though until 1987 they used text-based displays, not graphics.

Handheld LCD games

In 1979, [Milton Bradley Company](#) released the first handheld system using interchangeable cartridges, [Microvision](#). While the handheld received modest success in the first year of production, the lack of games, screen size and video game crash of 1983 brought about the system's quick demise.^[35]

In 1980, [Nintendo](#) released its [Game & Watch](#) line, [handheld electronic game](#) which spurred dozens of other game and toy companies to make their own portable games, many of which were copies of Game & Watch titles or adaptations of popular arcade games. Improving [LCD](#) technology meant the new handhelds could be more reliable and consume fewer batteries than [LED](#) or [VFD](#) games, most only needing watch batteries. They could also be made much smaller than most LED handhelds, even small enough to wear on one's wrist like a watch. [Tiger Electronics](#) borrowed this concept of videogaming with cheap, affordable handhelds and still produces games in this model to the present day.

Video game crash of 1983

At the end of 1983, several factors, including a market flooded with poor-quality games, the commercial failure of several important Atari 2600 titles, and [home computers](#) emerging as a new and more advanced gaming platform, caused the industry to experience a severe downturn. This was the "crash" of the video game industry. It bankrupted several companies that produced North American consoles and games from late 1983 to early 1984. It ended what is considered to be the second generation of console video gaming.

As a result of the crash, a globally important video gaming industry emerged in Japan, creating important room for companies like [Nintendo](#) and [Sega](#). This brought about the worldwide popularity of the third-generation [Nintendo Entertainment System](#), for which third-party game publishing was strictly overseen by Nintendo.

Third generation consoles (1983–1995) (8-bit)



The [Nintendo Entertainment System](#) or NES

Whilst a broken gaming industry in the US took several local businesses to bankruptcy and practically ended retail interest in video gaming products, an [8-bit](#) third generation of video game consoles started in Japan as early as 1983 with the release of both [Nintendo's Family Computer](#) ("Famicom") and [Sega's SG-1000](#) on July 15. The first clearly trumped the second in terms of commercial success in the country,

causing Sega to replace it, two years later, by a severely improved and modernized version called the [Sega Mark III](#).

In efforts to make the Famicom marketable in the US, Nintendo created a completely redesigned version of it, called the Nintendo Entertainment System (NES), to be sold in the country as a product unrelated to video gaming. For this same reason, the company also developed a toy robot accessory called the [R.O.B.](#) to be sold together with some versions. The NES was released on 18 October 1985 in the US, reviving the video game market in the country and proving successful to the American audience, peaking in popularity between 1987 and the early 1990s. The console was later released in other Western countries, but because of heavy competition from home computers such as the [ZX Spectrum](#), [Amstrad CPC](#) and [Commodore 64](#), and a lack of marketing, the NES was prevented from having as much success in Europe.

The Sega Mark III, released to Western consumers as the Master System, dominated the markets of Europe, Oceania and Brazil, selling more than the NES in these regions. Soon, the Famicom/NES and the Master System became the great consoles of the third generation. While Sega focused on unique gameplay experiences and innovative technology (with Master System's superior technical properties which allowed better graphics, and accessories like LCD glasses), Nintendo focused on creating long and popular game franchises which often repeated the same features.^[36] Despite different regional dominances, the Famicom/NES sold a superior sum of 61.91 million worldwide copies, against 14.8 million of the Master System.^{[37][38]}

In this generation, the [gamepad](#) or joystick, took over for [joysticks](#), [paddles](#), and [keypads](#) as the default [game controller](#). The gamepad design of an 8 direction Directional-pad (or [D-pad](#) for short) with 2 or more action buttons became the standard. This generation also marked a shift in the dominance of home video game console hardware and [console game](#) production from the United States to Japan.^[39]

The third console generation marked the debut of various high-profile role-playing franchises, such as [The Legend of Zelda](#), [Dragon Quest](#), [Phantasy Star](#) and [Final Fantasy](#), the latter of which financially saved Japanese developer [Square](#). 1987 saw the birth of the [stealth genre](#) with [Hideo Kojima](#)'s [Metal Gear](#) series' [first game](#), on the [MSX2](#) computer. In 1989, [Capcom](#) released [Sweet Home](#) on the NES, which served as a precursor to the [survival horror](#) genre.

In 1988, Nintendo published their first issue of [Nintendo Power](#) magazine.

By 1989 the market for cartridge-based console games was more than \$2 billion, while that for disk-based computer games was less than \$300 million.^[40] Large computer-game companies such as [Epyx](#), [Electronic Arts](#), and [LucasArts](#) began devoting much or all of their attention on console games. *Computer Gaming World* warned that computer gaming could become a "cultural backwater," similar to what had happened a few years earlier with 8-bit computers.^[41] In 1990, Commodore and Amstrad entered the console market with their [C64GS](#) and [GX4000](#) game machines respectively. These were both based on the 8-bit computers of their manufacturers, and had only limited success due to a lack of software support and the arrival of 16-bit machines. Amstrad's GX4000 sold just over 15,000 units, with only 25 officially released game cartridges. Even though it was technically superior to the Master System and Nintendo Entertainment System, it was discontinued after 6 months.

This generation ended with the discontinuation of the NES in 1995.

Fourth generation consoles (1987–2004) (16-bit)

A [16-bit](#) generation of video game consoles starts in the late 1980s. The [TurboGrafx-16](#), named the PC Engine in Europe and Japan, debuted in 1987 as the first commercial 16-bit game system. It had a large following in Japan, but, did poorly in North America and Europe because of its limited library of games and because of excessive distribution restrictions imposed by [Hudson Soft](#). Sega's [Mega Drive/Genesis](#) sold well worldwide early on after its debut in 1988. Nintendo responded with its own next generation system named the [Super Nintendo Entertainment System](#) (SNES), in 1990.



A model of the [TurboGrafx-16](#)

This time was one of intense competition and not entirely truthful marketing. The TurboGrafx-16 was billed as the first 16-bit system but its central processor was an 8-bit [HuC6280](#), with only its [HuC6270](#) graphics processor being a true 16-bit chip. Also, the much earlier Mattel [Intellivision](#) contained a 16-bit processor. Sega used the term "Blast Processing" throughout its marketing to describe the simple fact that their console's CPU ran at a higher [clock speed](#) than that of the SNES (7.67 [MHz](#) vs 3.58 MHz).

In Japan, the PC Engine was a very successful competitor against the [Famicom](#) and a CD drive peripheral allowed it to fend off the Mega Drive in 1988, though it never really caught on to the same degree outside Japan. The PC Engine eventually lost out to the [Super Famicom](#), but, due to its popular CD add-ons, retained enough of a user base to support new games well into the late 1990s.

CD-ROM drives were introduced in this generation, as add-ons for the PC Engine in 1988 and the Mega Drive in 1991. Nintendo experimented with optical media formats for the SNES in a joint venture with [Sony](#), who developed this concept into the [PlayStation](#) and rose to prominence as a major competitor to Nintendo and Sega. Basic [3D graphics](#) entered the mainstream with [flat-shaded](#) polygons enabled by added processors in game cartridges like [Virtua Racing](#) and [Star Fox](#), while the Mega Drive managed to produce such graphics without special processors, on the ≈ 8 MHz 68000 chip by using highly simplified polygon models, a slow frame rate (< 4 fps), and reduced resolution.

[Sonic the Hedgehog](#), released in 1991 for the Mega Drive/Genesis, gave the console mainstream popularity, and rivaled Nintendo's [Mario](#) franchise, starting the so-called "[console war](#)." Its [namesake character](#) became the mascot of Sega and one of the most recognizable video game characters in history.

[SNK's Neo-Geo](#) was the most costly console by a wide margin when released in 1990, and remained so for years. Its 2D graphics were of a quality years ahead of other consoles. The reason for this was that it contained the same hardware that was found in SNK's arcade games. This was the first time since the home Pong machines that a true-to-the-arcade experience could be had at home, but the system was commercially inviable.

This era also saw a revival of [handheld consoles](#), which were absent in the prior generation. Nintendo's [Game Boy](#), a portable released in 1989 with monochromatic 2D graphics and 35-hours battery life, became widely popular in the world and sold much more than its three competitors, the [Atari Lynx](#), Sega's [Game Gear](#) and NEC's [Turbo Express](#), released in Japan in North America until 1991. Despite these three consoles having much more sophisticated 16-bit graphics (similar to home consoles of the time), they had limited battery life. The other consoles also had scarce game libraries compared to over one thousand games released for the Game Boy, including best-selling titles [Pokémon Red and Blue](#), and which inspired an entire line of portable machines that continued through the following two generations.

1990s

The 1990s were a decade of marked [innovation](#) in video gaming. It was a decade of transition from [raster graphics](#) to [3D graphics](#) and gave rise to several genres of video games including [first-person shooter](#), [real-time strategy](#), and [MMO](#). Handheld gaming began to become more popular throughout the decade, thanks in part to the release of the [Game Boy](#) in 1989.^[42] Arcade games experienced a resurgence in the early-to-mid-1990s, followed by a decline in the late 1990s as [home consoles](#) became more common.

As arcade games declined, however, the home video game industry matured into a more mainstream form of entertainment in the 1990s, but their video games also became more and more [controversial](#) because of their violent nature, especially in games of [Mortal Kombat](#), [Night Trap](#), and [Doom](#), leading to the formation of the [Interactive Digital Software Association](#) and their rating games by signing them their [ESRB](#) ratings since 1994.^[43] Major developments of the 1990s include the popularizing of [3D computer graphics](#) using polygons (initially in arcades, followed by home consoles and computers), and the start of a larger consolidation of publishers, higher budget games, increased size of production teams, and collaborations with both the music and motion picture industries. Examples of this include [Mark Hamill](#)'s involvement with [Wing Commander III](#), the introduction of [QSound](#) with [arcade system boards](#) such as [Capcom](#)'s [CP System II](#), and the high production budgets of titles such as [Squaresoft](#)'s [Final Fantasy VII](#) and [Sega](#)'s [Shenmue](#).

Resurgence and decline of arcades

In North America, arcade games, which had seen a slow decline with the increase in popularity of home gaming, experienced a resurgence in the early-to-mid-1990s, with the 1991 release of [Capcom](#)'s [Street Fighter II](#)^[44] popularizing competitive one-on-one [fighting games](#) and reviving the arcade industry to a level of popularity not seen since the days of [Pac-Man](#).^[45] Its success led to a wave of other popular fighting games, such as [Mortal Kombat](#) and [The King of Fighters](#). [Sports games](#) such as [NBA Jam](#) also briefly became popular in arcades during this period.

Transition to 3D

[3D computer graphics](#) using polygons were soon popularized by [Yu Suzuki](#)'s [Sega AM2](#) games [Virtua Racing](#) (1992) and [Virtua Fighter](#) (1993), both running on the [Sega Model 1 arcade system board](#).^[46] Some of the [Sony Computer Entertainment](#) (SCE) staff involved in the creation of the original [PlayStation video game console](#) credit [Virtua Fighter](#) as inspiration for the PlayStation's 3D graphics hardware. According to SCE's former producer Ryoji Akagawa and chairman Shigeo Maruyama, the PlayStation was originally being considered as a [2D](#)-focused hardware, and it wasn't until the success of [Virtua Fighter](#) in the arcades that they decided to design the PlayStation as a 3D-focused hardware.^[47] [Texture mapping](#) and [texture filtering](#) were soon popularized by 3D [racing](#) and [fighting games](#).

However, with the advent of 32- and 64-bit consoles in the mid-1990s, home video game consoles such as the [Sega Saturn](#), [PlayStation](#) and [Nintendo 64](#) also became able to produce texture-mapped 3D graphics. Increasing numbers of players waited for popular arcade games to be ported to consoles rather than pumping coins into arcade kiosks. This trend increased with the introduction of more realistic peripherals for computer and console game systems such as [force feedback](#) aircraft joysticks and racing wheel/pedal kits, which allowed home systems to approach some of the realism and immersion formerly limited to the arcades. To remain relevant, arcade manufacturers such as [Sega](#) and [Namco](#) continued pushing the boundaries of 3D graphics beyond what was possible in homes. [Virtua Fighter 3](#) for the [Sega Model 3](#), for instance, stood out for having real-time 3D graphics approaching the quality of [CGI full motion video](#) (FMV) at the time.^[48] Likewise, Namco released the [Namco System 23](#) to rival the Model 3. By 1998, however, Sega's [new console](#), the [Dreamcast](#), could produce 3D graphics on-par with the [Sega Naomi](#) arcade machine. After producing the more powerful [Hikaru](#) board in 1999 and [Naomi 2](#) in 2000, Sega eventually stopped manufacturing custom arcade system boards, with their subsequent arcade boards being based on either consoles or commercial PC components.

As patronage of arcades declined, many were forced to close down. Classic coin-operated games have largely become the province of dedicated hobbyists and as a tertiary attraction for some businesses, such as movie theaters, [battling cages](#), [miniature golf](#) courses, and arcades attached to game stores such as [F.Y.E.](#)

The gap left by the old corner arcades was partly filled by large amusement centers dedicated to providing clean, safe environments and costly game control systems unavailable to home users. These newer arcade titles offered games based on driving, sports like skiing or cycling, and [rhythm games](#) like [Dance Dance Revolution](#) and path-based shooting gallery games like [Time Crisis](#), which have taken a large part of the market. [Dave & Buster's](#) and [GameWorks](#) are two large chains in the United States with this type of environment. Aimed at adults and older kids, they feature full service restaurants with full liquor bars and have a wide variety of video game and hands on electronic gaming options. [Chuck E. Cheese's](#) is a similar type of business for younger children.

Handhelds come of age

In 1989, Nintendo released the [Game Boy](#), the first [handheld game console](#) since the ill-fated [Microvision](#) ten years before. The design team headed by [Gunpei Yokoi](#) had also been responsible for the [Game & Watch](#) systems. Included with the system was [Tetris](#), which became one of the best sold video games of all time and was ported to a large variety of systems. Several rival handhelds made their debut in the early 90s, including the [Sega Game Gear](#) and [Atari Lynx](#) (the first handheld with color LCD display). Although these systems were more technologically advanced, they were hampered by higher battery consumption and less third-party developer support. While some of the other systems remained in production until the mid-1990s, the [Game Boy](#), and its successive incarnations the [Game Boy Pocket](#), [Game Boy Color](#) and [Game Boy Advance](#), were virtually unchallenged for dominance in the handheld market, until the [PlayStation Portable](#) was released in 2004 to compete with Nintendo's successor to the Game Boy line, the [Nintendo DS](#).

PC gaming

The increasing computing power and decreasing cost of processors such as the [Intel 80386](#), [Intel 80486](#), and [Motorola 68030](#), caused the rise of [3D graphics](#), and [multimedia](#) abilities through [sound cards](#) and [CD-ROMs](#). Early 3D games began with [flat shading](#) graphics ([Elite](#), [Starglider 2](#) or [Alpha Waves](#)),^[49] and then simple forms of texture mapping.

1989 and the early 1990s saw the release and spread of the Multi-User Dungeon ([MUD](#)) codebases [DikuMUD](#) and [LPMud](#), leading to a tremendous increase in the proliferation and popularity of MUDs. Before the end of the decade, the evolution of the genre continued through [graphical MUDs](#) into the first [massively multiplayer online role-playing games](#) (MMORPGs), which freed users from the limited number of simultaneous players in other games and brought [persistent worlds](#) to the mass market.

In the early 1990s, [shareware](#) distribution was a popular method of publishing games for smaller developers, including then-fledgling companies such as Apogee (now [3D Realms](#)), Epic MegaGames (now [Epic Games](#)), and [id Software](#). This gave consumers the chance to try a trial portion of the game, usually restricted to a game's complete first section or "episode", before purchasing the full game. Racks of games on single 5¼" and later 3.5" [floppy disks](#) were common in computer stores, often only costing a few dollars each. Since the shareware versions were essentially free, the cost only needed to cover the disk and minimal packaging. As the increasing size of games in the mid-1990s made them impractical to fit on floppies, and retail publishers and developers began to earnestly mimic the practice, shareware games were replaced by shorter [game demos](#) (often only one or two levels), distributed free on CDs with gaming magazines and over the Internet.

[Real-time strategy](#) became a popular genre of computer games in the early 90s, with [Dune II](#) setting the standard game mechanics of many games since. Meanwhile, [Alone in the Dark](#) influenced the [survival-horror](#) genre with its [action-adventure](#) elements. It established the formula that later flourished on CD-ROM-based consoles, with games such as [Resident Evil](#), which coined the name "survival horror" and popularized the genre, and [Silent Hill](#).

Graphic adventure games continued to evolve during this period, with the creation of the point-and-click genre. Some of the genre's most prolific titles were being produced by [Sierra Entertainment](#) and [LucasArts](#) during the 90s, and [Myst](#) and its sequels inspired a new style of puzzle-based adventure games. It was in the 1990s that [Maxis](#) began publishing its successful [line of "Sim" games](#), starting with [SimCity](#), and continuing with a variety of titles, such as [SimEarth](#), [SimCity 2000](#), and eventually [The Sims](#), which was first released in early 2000.

In 1996, [3dfx Interactive](#) released the Voodoo chipset, leading to the first affordable [3D accelerator cards](#) for personal computers. These devoted 3D rendering [daughterboards](#) performed a portion of the computations and memory-handling required for more-detailed three-dimensional graphics (mainly texture filtering), allowing for more-detailed graphics than would be possible if the CPU were required to handle both game logic and all the graphical tasks. [First-person shooters](#) (FPS) were among the first to take advantage of this new technology. While other games also made use of it, the FPS became the main driving force behind the development of new 3D hardware, and the yardstick by which its performance was measured, usually quantified as the number of frames per second rendered for a given scene in a given game.

Several other less mainstream genres were created in this decade. [Looking Glass Studios' *Thief: The Dark Project*](#) and its sequel were the first to coin the term "first person sneaker,"^[50] and the turn-based strategy progressed further, with the [Heroes of Might and Magic](#) series popularizing the thus far niche and complex genre.

[Id Software](#)'s 1996 game [Quake](#) pioneered play over the Internet in [first-person shooters](#). Internet multiplayer ability became a de facto requirement in most FPS games since. Other genres also began to offer online play in the late 90s, including real-time strategy games as [Age of Empires](#), the [Warcraft](#) and [StarCraft](#) series, and [turn-based](#) games such as [Heroes of Might and Magic](#). Developments in [web browser plug-ins](#) like [Java](#) and [Adobe Flash](#) allowed for simple [browser-based games](#).

Fifth generation consoles (1993–2005) (32- and 64-bit)



The [Sony PlayStation](#).



The [Sega Saturn](#)

In 1993, Atari re-entered the home console market with the introduction of the [Atari Jaguar](#). Also in 1993, [The 3DO Company](#) released the [3DO Interactive Multiplayer](#), which, though highly advertised and promoted, failed to catch up to the sales of the Jaguar, due to its high pricetag. Both consoles had very low sales and few quality games, eventually leading to their demise. In 1994, three new consoles were released in Japan: the [Sega Saturn](#), the [Sony PlayStation](#), and the [PC-FX](#), the Saturn and the PlayStation later seeing release in North America in 1995. The PlayStation quickly outsold all of its competitors mainly on the strength of its available titles, with the exception of the aging [Super Nintendo Entertainment System](#), which still had the support of many major game companies.

The [Virtual Boy](#) from Nintendo was released in 1995 as one of the first consumer consoles providing 3D depth perception, but did not achieve high sales, largely due to the monochrome display and the lack of third-party support. In 1996 the Virtual Boy was taken off the market.

After many delays, during which Sony's PlayStation gained industry acceptance, Nintendo released its [64-bit](#) console, the [Nintendo 64](#) in 1996. The console's flagship title, [Super Mario 64](#), became a defining title for 3D platformer games.

[PaRappa the Rapper](#) popularized [music video games](#) in Japan with its 1996 debut on the [PlayStation](#). Subsequent music and dance games like [beatmania](#) and [Dance Dance Revolution](#) became ubiquitous attractions in Japanese arcades. While [Parappa](#), [DDR](#), and other games found a cult following when brought to North America, music games did not gain a wide audience in the market until the next decade with titles like [Guitar Hero](#). Also in 1996 [Capcom](#) released [Resident Evil](#), the first well known survival horror game. It was a huge success selling over 2 million copies and is considered one of the best games on the PlayStation.

Other milestone games of the era include [Rare's](#) Nintendo 64 title [GoldenEye 007](#) (1997), which was critically acclaimed for bringing innovation as being the first major first-person shooter that was exclusive to a console, and for pioneering certain features that became staples of the genre, such as scopes, headshots, and objective-based missions. [The Legend of Zelda: Ocarina of Time](#) (1998) for the Nintendo 64 is one of the [most critically acclaimed games of all time](#), and is still the highest ranked game across all platforms on video game aggregator [Metacritic](#). The title also featured many innovations such as [Z-targeting](#), which has persisted through subsequent Zelda titles on newer consoles and is commonly used in many other franchises today.

Nintendo's choice to continue using ROM cartridges instead of moving to CD-ROMs for the Nintendo 64, unique among the consoles of this period, proved to have negative consequences for the console and for Nintendo's market share. While cartridges had faster access times, were more durable and resistant to unlicensed copying, CDs could hold far more data (650MB, over ten times the capacity of the largest N64 ROM at 64MB) and cost far less to produce, causing many game companies to turn to Nintendo's CD-based competitors. Notably, [Square](#), which had released all prior games in its [Final Fantasy](#) series for Nintendo consoles, now turned exclusively to the PlayStation; [Final Fantasy VII](#) (1997) was a massive success, establishing the popularity of [role-playing video games](#) in the west and making the PlayStation the primary console for the genre, taking the crown from Nintendo who had enjoyed it with the SNES and Square's then Nintendo-exclusive [Final Fantasy](#), [Secret of Mana](#) and [Chrono Trigger](#) titles. Copies of FFVII still command like-new prices of between US\$30–\$50 on the used market. Square did not return to Nintendo's main console platforms until 2003 with the [GameCube](#) and the cross-platform title [Final Fantasy Crystal Chronicles](#) (the only Square-published title for that console), and after FFVI for the SNES, Square did not release a "main series" Final Fantasy title for a Nintendo platform until 2019.^[51] [Capcom](#) also largely departed from Nintendo during the N64 days; the next 4 installments of its popular [Mega Man](#) 2D platform shooter were released on PlayStation and Saturn. Capcom was somewhat quicker and more eager to return than Square, however, providing two anthologies of Mega Man titles for the [GameCube](#), including Mega Man 8 and Mega Man X4-6 that Nintendo players had missed.

By the end of this period, Sony had become the leader in the video game market. The Saturn was moderately successful in Japan but a commercial failure in North America and Europe, leaving Sega outside of the main competition. The N64 achieved huge success in North America and Europe, though it never surpassed PlayStation's sales or was as popular in Japan, and began to show a decline in third-party support for Nintendo's home consoles.

This generation ended with the discontinuation of the PlayStation (known in its re-engineered form as the "PSOne") in March 2005.

Transition to 3D and CDs

The fifth generation is most noted for the rise of fully [3D](#) games. While there were games prior that had used three dimensional environments, such as [Virtua Racing](#) and [Star Fox](#), it was in this era that many game designers began to move traditionally [2D](#) and [pseudo-3D](#) genres into full 3D. [Super Mario 64](#) and [The Legend of Zelda: Ocarina of Time](#) on the N64, [Crash Bandicoot](#), and [Spyro the Dragon](#) on the PlayStation and [Nights into Dreams...](#) on the Saturn, are prime examples of this trend. Their 3D environments were widely marketed, and they steered the industry's focus away from side-scrolling and rail-style titles, and opened doors to more complex games and genres. Games like [GoldenEye 007](#), [Ocarina of Time](#) or [Virtua Fighter](#) were nothing like shoot-em-ups, RPGs or fighting games before them. 3D became the main focus in this period, as was a slow decline of cartridges in favor of CDs, which allowed far greater storage capacity than what formerly possible. The N64 was the last major home console to use the cartridge format, although it persists to this day in handheld games on Nintendo and Sony devices using memory cards similar to [Secure Digital](#) (SD) cards.

Mobile phone gaming

Mobile phones began becoming video gaming platforms when [Nokia](#) installed [Snake](#) onto its line of mobile phones in 1997 (Nokia 6110).^[52] As the game gained popularity, every major phone brand offered "time killer games" that could be played in very short moments such as waiting for a bus. [Mobile phone games](#) early on were limited by the modest size of the phone screens that were all monochrome, the very limited amount of memory and processing power on phones, and the drain on the battery.

2000s

The 2000s (decade) showed innovation on both consoles and PCs, and an increasingly competitive market for portable game systems.

The phenomena of user-created [modifications](#) (or "mods") for games, one trend that began during the [Wolfenstein 3D](#) and [Doom](#)-era, continued into the start of the 21st century. The most famous example is that of [Counter-Strike](#); released in 1999, it is still one of the most popular online first-person shooter, even though it was created as a mod for [Half-Life](#) by two independent programmers. Eventually, game designers realized the potential of mods and custom content in general to enhance the value of their games, and so began to encourage its creation. Some examples of this include [Unreal Tournament](#), which allowed players to import 3dsmax scenes to use as character models, and [Maxis' The Sims](#), for which players could create custom objects.

In China, video game consoles were banned in June 2000. This has led to an explosion in the popularity of computer games, especially MMOs. Consoles and the games for them are easily acquired however, as there is a robust grey market importing and distributing them across the country. Another side effect of this law has been increased copyright infringement of video games.^{[53][54]}

Sixth generation consoles (1998–2013)

In the sixth generation of video game consoles, Sega exited the hardware market, Nintendo fell behind, Sony solidified its lead in the industry, and Microsoft developed their first gaming console.

The generation opened with the launch of the Sega [Dreamcast](#) in 1998. As the first console with a built-in modem for Internet support and online play, it was initially successful, but sales and popularity declined rapidly. This has been attributed to Sega's damaged reputation from the relative failures of the 32X and Saturn, copyright infringement, and the huge anticipation for the upcoming [PlayStation 2](#). The Dreamcast's library contains many titles considered creative and innovative, including the [Shenmue series](#) which are regarded as a major step forward for 3D [open-world](#) gameplay^[55] and has introduced the [quick time event](#) mechanic in its modern form.^[56] Production for the console discontinued in most markets by 2002 and it was Sega's final console before Sega reorganized its business as a third-party game provider only, partnering primarily with its old rival Nintendo.

The second console of the generation, released in 2000, was Sony's PlayStation 2 (PS2), which featured DVD-based game discs with 4.7GB capacity, increased processor and graphics ability over its predecessor including progressive-scan component video connections, built-in 4-player connection, available Ethernet adapter (which became built-in with the winter 2004 release of the "slimline" PS2 chassis), and the ability to play DVD movies and audio CDs, eliminating the need for a separate DVD player and making the PS2 a complete home entertainment console. The console was highly successful during the generation.

Nintendo followed a year later with the [GameCube](#) (code-named "Dolphin" while in development), the company's first optical disc-based console. While it had the component-video ability of its contemporaries, the GameCube suffered in several ways compared to Sony's PS2. First, the PS2's high anticipation and one-year head start gained it player and developer attention before the GCN's release. As a result, the GameCube had less third-party backing and very few third-party exclusives, mostly from Nintendo-faithful studios such as [Rare](#) and the now-defunct [Midway Games](#). Cross-platform giants like [Capcom](#), [Electronic Arts](#) and [Activision](#) released most of their GameCube titles on other consoles as well, while [Square Enix](#) released high-demand PS2 exclusives. The GCN's game disc capacity was a third that of the PS2's full-size DVD disks, forcing a few games to be released on multiple discs and most titles to compromise on texture quality and other features of GameCube games, when other platforms had no such limitations on their versions. It had no [backward compatibility](#) with the now-obsolete cartridges of the N64. It was a dedicated game console, with the optical drive being too small to hold a full-size CD or DVD. Lastly, The GameCube was hindered by a reputation for being a "kid's console", due to its initial launch color scheme and lack of mature-content games which the current market appeared to want. Though T- and M-rated titles did exist on the GameCube, almost all GCN games were E-rated and mostly cartoon-style in their art design.



The [Xbox](#), Microsoft's entry into the video game console industry

Before the end of 2001, Microsoft Corporation, best known for its [Windows](#) operating system and its professional productivity software, entered the console market with the [Xbox](#). Based on Intel's Pentium III CPU, the console used a great deal of PC technology to leverage its internal development, making games for PC easily portable to the Xbox. To gain market share and maintain its toehold in the market, Microsoft reportedly sold the Xbox at a significant loss^[52] and concentrated on drawing profit from game developing and publishing. Shortly after its release in November 2001 [Bungie](#) Studio's [Halo: Combat Evolved](#) instantly became the driving point of the Xbox's success, and the [Halo series](#) became one of the most successful console shooter franchises of all time. By the end of the generation, the Xbox had drawn even with the Nintendo GameCube in sales globally, but since nearly all of its sales were in North America, it pushed Nintendo into third place in the American market.

In 2001 [Grand Theft Auto III](#) was released, popularizing open world games by using a non-linear style of gameplay. It was very successful both critically and commercially and is considered a huge milestone in gaming. It was also yet another set piece in the debate over video game violence and adult content, with advocacy groups decrying the series' glorification of prostitution, the mafia, and violence, including that against first responders such as police and EMS.

Nintendo still dominated the handheld gaming market during this period. The [Game Boy Advance](#), released in 2001, maintained Nintendo's market position with a high-resolution, full-color LCD screen and 32-bit processor allowing ports of SNES games and simpler companions to N64 and GameCube games.^[53] Finnish cellphone maker Nokia entered the handheld scene with the [N-Gage](#), but it failed to win a significant following.

In January 2013, Sony announced that the PlayStation 2 had been discontinued worldwide, ending the sixth generation.

Return of alternative controllers

One significant feature of this generation was various manufacturers' renewed fondness for add-on peripheral controllers. While alternative controllers weren't new (Nintendo supported several for the NES and PC games have long supported driving wheels and aircraft joysticks), console games built around them became some of the biggest hits of the decade. Konami sold a soft-plastic mat version of its foot controls for its [Dance Dance Revolution](#) franchise in 1998. Sega came out with [Samba de Amigo's](#) maraca controllers. Nintendo's [bongo controller](#) worked with a few games in its [Donkey Kong](#) franchise. Publisher [RedOctane](#) introduced [Guitar Hero](#) and its distinctive guitar-shaped controllers for the PlayStation 2. Meanwhile, Sony developed the [EyeToy](#) peripheral, a camera that could detect player movement, for the PlayStation 2. This was further developed into whole-body tracking technologies such as Sony's PlayStation Move and Microsoft's Kinect.

Online gaming rises to prominence

As affordable broadband Internet connectivity spread, many publishers turned to online gaming as a way of innovating. [Massively multiplayer online role-playing games](#) (MMORPGs) featured significant titles for the PC market like [RuneScape](#), [World of Warcraft](#), [EverQuest](#), and [Ultima Online](#). Historically, console-based MMORPGs have been few in number due to the lack of bundled Internet connectivity options for the platforms. This made it hard to establish a large enough subscription community to justify the development costs. The first significant console MMORPGs were [Phantasy Star Online](#) on the Sega [Dreamcast](#) (which had a built in modem and aftermarket Ethernet adapter), followed by [Final Fantasy XI](#) for the Sony [PlayStation 2](#) (an aftermarket Ethernet adapter was shipped to support this game). Every major platform released since the Dreamcast has either been bundled with the ability to support an Internet connection or has had the option available as an aftermarket add-on. Microsoft's Xbox also had its own

online gaming service called [Xbox Live](#). Xbox Live was a huge success and proved to be a driving force for the Xbox with games like [Halo 2](#) that were highly popular.

Mobile games

In the early 2000s (decade), mobile games had gained mainstream popularity in [Japanese mobile phone culture](#), years before the United States or Europe. By 2003, a wide variety of mobile games were available on Japanese phones, ranging from [puzzle games](#) and [virtual pet](#) titles that use [camera phone](#) and [fingerprint scanner](#) technologies to [3D](#) games with [PlayStation](#)-quality graphics. Older [arcade-style games](#) became very popular on mobile phones, which were an ideal platform for arcade-style games designed for shorter play sessions. Namco began making attempts to introduce mobile gaming culture to Europe in 2003.^[59]

Mobile gaming interest was raised when Nokia launched its [N-Gage](#) phone and handheld gaming platform in 2003. While about two million handsets were sold, the product line wasn't seen as a success and was withdrawn from Nokia's lineup. Meanwhile, many game developers had noticed that more advanced phones had color screens and enough memory and processing power to do reasonable gaming. Mobile phone gaming revenues passed 1 billion dollars in 2003, and passed 5 billion dollars in 2007, accounting for a quarter of all videogaming software revenues. More advanced phones came to the market such as the N-Series [smartphone](#) by Nokia in 2005 and the [iPhone](#) by Apple in 2007 which strongly added to the appeal of mobile phone gaming. In 2008 Nokia didn't revise the N-Gage brand, but published a software library of games to its top-end phones. At Apple's App Store in 2008, more than half of all applications sold were iPhone games.

Due to the debut of app stores created by [Apple](#) and [Google](#), plus the low-cost retail price of downloadable phone apps, games available on smartphones increasingly rival the video game console market. Among the most successful mobile games of this period is [Angry Birds](#), which, released in 2009, reached 2 million downloads within one year.^[60] Nintendo announced their intentions for developing more games and content for mobile devices in the early 2010s,^[61] while Sega company is also dedicating development resources toward creating more mobile games.^[62] Independent small developers are entering the game market en masse by creating mobile games with the hope they will gain popularity with smartphone gaming enthusiasts.^[63]

Since 2007, the fast growing mobile market in African countries such as [Nigeria](#) and [Kenya](#) has also resulted in a growth in mobile game development. Local developers have taken advantage of the recent increase in mobile internet connection in countries where [broadband](#) is rarely available and console games are costly, though locally developed applications have difficulty competing against millions of western applications available on the [Google Play Store](#)^{[64][65][66]}

Seventh generation consoles (2005–present)

The generation opened early for handheld consoles, as Nintendo introduced their [Nintendo DS](#) and Sony premiered the [PlayStation Portable](#) (PSP) within a month of each other in 2004. While the PSP boasted superior graphics and power, following a trend established since the mid-1980s, Nintendo gambled on a lower-power design but featuring a novel control interface. The DS's two screens proved extremely popular with consumers, especially young children and middle-aged gamers, who were drawn to the device by Nintendo's [Nintendogs](#) and [Brain Age](#) series respectively. The PSP attracted a significant portion of veteran gamers in North America and was very popular in Japan, though a large portion of its [visual novels](#) and [anime](#)-based games have never been localized in the west. This combined allowed Nintendo to continue its dominance in handheld gaming. Nokia withdrew their [N-Gage](#) platform in 2005 but reintroduced the brand as a game-oriented service for high-end smartphones on April 3, 2008.^[67]

In console gaming, Microsoft stepped forward first in November 2005 with the [Xbox 360](#), and Sony followed in 2006 with the [PlayStation 3](#), released in Europe in March 2007. Setting the technology standard for the generation, both featured high-definition graphics over HDMI connections, large hard disk-based secondary storage for save games and downloaded content, integrated networking, and a companion on-line gameplay and sales platform, with [Xbox Live](#) and the [PlayStation Network](#) respectively. Both were formidable systems that were the first to challenge personal computers in power (at launch), while offering a relatively modest price compared to them. While both cost more than most past consoles, the Xbox 360 enjoyed a substantial price edge, selling for either \$300 or \$400 depending on model, while the PS3 launched with models priced at \$500 and \$600. Coming with [Blu-ray Disc](#) and [Wi-Fi](#), the PlayStation 3 was the most costly game console on the market since Panasonic's version of the 3DO, which retailed for

little under \$700.^[68] The PlayStation 3's high price led to the console being defeated by the Xbox 360 (also resulting in Xbox 360 gaining market leadership until 2008), thus breaking the streak of dominance that the PlayStation brand once had, which was started in 1994 with the success of the original PlayStation. However, the [slim model](#) and the [PlayStation Move](#) controllers caused a massive recovery for PlayStation 3, and by 2013 the console outsold Xbox 360.

In this generation, Nintendo not only secured its dominance in the handheld video game market, but also successfully regained total dominance on both the home video game market and the entire video game industry with the release of its home console, the [Wii](#). While the Wii had lower technical specifications than both the Xbox 360 and PlayStation 3,^[69] only a modest improvement over the GameCube and the only 7th-gen console not to offer HD graphics, its new motion control was much touted, and its lower pricepoint of around \$200–\$250 appealed to a larger demographic. Nintendo took cues from PC gaming and their crafted games that capitalized on the intuitive nature of motion control. Emphasis on gameplay turned comparatively simple games into unlikely runaway hits, such as [Wii Sports](#), [Wii Sports Resort](#), and [Wii Fit](#). Many gamers, publishers, and analysts initially dismissed the Wii as an underpowered curiosity, but were surprised as the console sold out through the 2006 Christmas season, and remained so through the next 18 months, becoming the fastest selling game console in most of the world's gaming markets.^[70] As a result, the Wii became a global success and the runaway market leader of the seventh generation of consoles. As of September 2013, the Wii has sold 100.3 million units worldwide and is currently Nintendo's best selling home console.^[71]

In June 2009, Sony announced that it would release its [PSP Go](#) for US\$249.99 on October 1 in Europe and North America, and Japan on November 1. The PSP Go was a newer, slimmer version of the PSP, which had the control pad slide from the base, where its screen covers most of the front side.^[72]

Seventh generation consoles



An original [Nintendo DS](#)



A original [PlayStation Portable](#)



An original model [Xbox 360](#) Premium and controller



An original model [PlayStation 3](#)



An original model [Wii](#) and [Wii Remote](#). It not only became a global success for Nintendo, but also made a massive gaming trend of playing with motion control.

Increases in development budgets

With high-definition video an undeniable hit with veteran gamers seeking immersive experiences, expectations for visuals in games along with the increasing complexity of productions resulted in a spike in the development budgets of gaming companies. While some game studios saw their Xbox 360 projects pay off, the unexpected weakness of PS3 sales resulted in heavy losses for a few developers, and many publishers broke formerly arranged PS3 exclusivity arrangements or cancelled PS3 game projects entirely due to rising budgets.

Rise of casual PC games

Starting with PCs, a new trend in [casual games](#), with limited complexity and designed for shortened or impromptu play sessions, began to draw attention from the industry. Many were puzzle games, such

as [Popcap's *Bejeweled*](#) and [PlayFirst's *Diner Dash*](#), while others were games with a more relaxed pace and open-ended play. The biggest hit was [The Sims](#) by [Maxis](#), which went on to become the best selling computer game of all time, surpassing [Myst](#).^[73]

Other casual games include [Happy Farm](#) and [Zynga](#) games like [Mafia Wars](#), [FarmVille](#), and [Café World](#), among many others, which are tied into [social networking](#) sites such as [Myspace](#), [Facebook](#), and [Mixi](#). These games are typically free to play, with the option to buy in game items and stats with money and/or reward offers.

In 2008, [social network games](#) began gaining mainstream popularity following the release of [Happy Farm](#) in China.^[74] Influenced by the [Japanese console RPG](#) series [Story of Seasons](#),^{[75][76][77]} [Happy Farm](#) attracted 23 million daily active users in China.^{[78][79]} It soon inspired many clones such as [Sunshine Farm](#), [Happy Farmer](#), [Happy Fishpond](#), [Happy Pig Farm](#),^{[75][80]} and Facebook games such as [FarmVille](#), [Farm Town](#), [Country Story](#), [Barn Buddy](#), [Sunshine Ranch](#), [Happy Harvest](#), [Jungle Extreme](#), and [Farm Villain](#).^{[77][81]} The most popular social network game is [FarmVille](#), which has over 70 million active users worldwide.^[74] Other popular social network games include [YoVille](#), [Mob Wars](#), [Mafia Wars](#), and [FrontierVille](#).

Cloud computing comes to games

In 2009, a few [cloud computing](#) services were announced targeted at video games. These services allow the graphics rendering of the video games to be done away from the end user, and a video stream of the game to be passed to the user. [OnLive](#) allows the user to communicate with their servers where the video game rendering is taking place.^{[82][83]} [Gaikai](#) streams games entirely in the user's browser or on an internet-enabled device.^[84] Experts estimate the streaming games market will grow nine-fold by 2017, reaching 8 billion dollars.^[85]

2010s

The new decade saw the rising interest in the possibility of the next generation of consoles being developed in keeping with the traditional industry model of a five-year console life cycle. However, in the industry there was believed to be a lack of desire for another race to produce such a console.^[86] Reasons for this included the challenge and massive expense of creating consoles that were graphically superior to the, then, current generation, with Sony and Microsoft still looking to recoup development costs on their current consoles and the failure of content creation tools to keep up with the increased demands placed upon the people creating the games.

On June 14, 2010, during E3, Microsoft revealed their new Xbox 360 console referred to as the Xbox 360 S or Slim. Microsoft made the unit smaller and quieter, while also installing a 250GB hard drive and built-in 802.11n WiFi.^[87] It started shipping to US stores the same day, not reaching Europe until July 13.

The Onlive cloud-based gaming system was one of the first cloud gaming systems known in video game history.

Eighth generation consoles (2012–present)

The [Nintendo 3DS](#) is a handheld video game console, revealed at Nintendo's E3 2010 press conference. Released in Japan in February 2011, it was released worldwide less than a month later. It uses [autostereoscopic](#) 3D to produce a 3D effect on-screen.

On January 27, 2011, the [PlayStation Vita](#) (code-named Next Generation Portable, or NGP, during development)^[88] was announced. It has a 5-inch [OLED](#) multi touch front screen and a rear touch pad, two analog sticks, 3G and WiFi connection, Sixaxis control and 3-axis electronic compass. It was released on December 17 in Japan^[89] and has been released on 15 (first edition bundle) and on February 22, 2012 in Europe (3G/ WiFi Vita, release bundle Vita, or the WiFi only Vita), as well as in the Middle East, Australia and North America.^[90] Sony is looking to have up to forty launch titles for the western release and up to 100 within the release window.^[91]

The [Wii U](#) is a video game console from [Nintendo](#). Billed as the successor to the [Wii](#), it was mentioned in statement released by Nintendo on April 25, 2011, that the company was planning to reveal it during [E3 2011](#) and that playable console units would be present as well.^[92] Code-named *Project Café*, it was officially introduced on June 7, 2011 with its final name, Wii U. The console released in North America on

November 18, and in Europe, Australia and New Zealand on November 30, 2012, officially starting the "eighth generation" of video game consoles. Features of the new console include [HD](#) graphics support (on Wii U only), and a controller, the [Wii U GamePad](#), which features a 6.2 inch touch screen built-in that can be used as a [second screen](#) providing added info and interactivity, such as "asymmetric gameplay". The Wii U GamePad allows some games to be played without needing a TV set, through [Off-TV Play](#). Most peripheral hardware from its predecessor, the Wii, such as the [Wii Remote](#) and [Wii Nunchuk](#), [Classic Controller](#) and [Wii Balance Board](#) are confirmed to work with the new console, and the console is [backward compatible](#) with all Wii and [Virtual Console](#) titles. The Wii U discontinues backward-compatibility support for [GameCube](#) discs and controllers, which also means that Wii games that support the GameCube's controller will instead require use of an alternate control scheme such as the Classic Controller when playing them on the Wii U. The Wii U also has its own more conventional controller, the [Wii U Pro Controller](#), which resembles an Xbox 360 controller in form and function and is compatible with most Wii U and Virtual Console titles, but not original Wii games. The console is available in two sets. The basic set includes the Wii U console with 8 GB of internal memory, the Wii U GamePad, an AC adapter, an HDMI cable and the [Wii Sensor Bar](#). The Deluxe set includes all of the items in the basic set, but it has 32 GB of internal memory instead of only 8 GB and is bundled with a GamePad charging cradle, stands for the GamePad and the console, as well as [Nintendo Land](#). The Sensor Bar is not included in the basic set in Europe, Australia and New Zealand.

The [PlayStation 4](#) (or PS4) is a video game console from Sony Computer Entertainment. Billed as the successor to the PlayStation 3, the PlayStation 4 was officially announced at a press conference on February 20, 2013. The fourth home console in Sony's PlayStation series, it was launched on November 15, 2013 in North America and on November 29, 2013 in Europe, and was launched on February 22, 2014 in Japan. Moving away from the Cell architecture, the PlayStation 4 is the first in the Sony series to feature compatibility with the x86 architecture, specifically x86-64, which is a widely used platform common in many modern PCs. The idea is to make video game development easier on the next-generation console, attracting a broader range of developers large and small. These changes highlight Sony's effort to improve upon the lessons learned during the development, production and release of the PS3. Other notable hardware features of the PlayStation 4 include 8 GB of GDDR5 RAM memory and a faster Blu-ray drive.

The [Xbox One](#) is a video game console from Microsoft. Billed as the successor to the Xbox 360, the Xbox One was officially announced at a press conference on May 21, 2013. Microsoft had intended to implement strict controls over game resale and DRM controls, but later reversed its decision due to public backlash. It is the third home console in Microsoft's Xbox series^[93] and launched on November 22, 2013 in North America, United Kingdom, Spain, Mexico, Italy, Ireland, Germany, France, Canada, Brazil, Austria, New Zealand and Australia.^[93] The release was delayed until sometime in 2014 in eight European countries (Belgium, Denmark, Finland, Netherlands, Norway, Russia, Sweden and Switzerland) due to various localization issues.

The Wii U was met with [slow consumer adoption](#), with low sales primarily credited to a weak lineup of [launch titles](#),^[94] third-party support,^[95] and marketing reasons.^[96] Wii U production officially ended in January 2017.^[97] On March 3, 2017, Nintendo released a new flagship home console, the [Nintendo Switch](#), although the Wii U was noted for pioneering several concepts that were refined in the Switch.^[98] The Nintendo Switch's software supports [online gaming](#) through standard Internet connectivity, as well as local [wireless ad hoc](#) connectivity with other Switch consoles. Nintendo Switch games and software are available on both physical [flash-based ROM cartridges](#) and [digital distribution](#) via [Nintendo eShop](#); the system does not use [region locking](#). The Nintendo Switch competes on the console gaming market with contemporaries being [Sony's PlayStation 4](#) and [Microsoft's Xbox One](#).

Eighth generation consoles



An original [Nintendo 3DS](#)



A [PlayStation Vita](#)



A [Wii U](#)



A [PlayStation 4](#)



An [Xbox One S](#)



A [Nintendo Switch](#)