

Apple history overview

I. Scope:

This timeline covers the history of Apple computer from the late 1970's to 1990. It tracks the technological changes within Apple's four major product lines during the period, the Apple II, Apple III, Lisa and Macintosh.

II. Terms:

Expandability- Extent to which users are able to add extra memory and secondary data storage to a particular computer model. Generally this referred to the number of expansion slots on the motherboard into which expansion cards could be added. This involved disassembling the case of the computer and was considered the purview of advanced users. As a result, computers designed for non-programmers among the general public, such as the original Mac, had a "closed architecture" that didn't provide expansion slots.

Microcomputer – Tiny in comparison to room-sized minicomputers, the first microcomputers fit on a tabletop. A microcomputer is an electronic device consisting of a power supply and a printed circuit board containing a central processing unit (microprocessor) and memory chips for input and output.

Personal Computer – As originally conceived, a "personal computer" was a microcomputer designed to be operated by a single person. Until the mid-1980's, the term "PC" was specifically reserved for business computers, as home computers were generally assembly-kit machines used for video games or hobby programming.

Memory: a medium or device capable of receiving, retaining, and outputting data in binary form. More specifically "memory" refers to main or primary data storage and transmission (ROM and RAM) rather than secondary or auxiliary storage and transmission (via floppy disks and hard disks).

RAM (random-access memory) – RAM is working or temporary memory. Continually changing and impermanent, it depends on a continuous electric current and is thus "volatile."

ROM (read-only memory) – ROM is permanent, static or nonvolatile memory; it cannot be changed and does not depend on a continuous electric current. ROM is programmed as a step in manufacture. It is needed to boot the system when it is turned on and to operate software.

Graphical User Interface- In contrast to the "fill-in-the-blank," text-command-driven interface of the earliest computers, the Graphical User Interface is "multiple choice" or menu-driven. The "point-and-click" configuration is designed with an object-oriented,

rather than text-oriented programming language, and involves a pointing device and icons. The mouse-controlled pointer allows users to select options from pop-up menus and icons, and to view information on the screen via overlapping windows and scroll bars. The GUI was introduced by Xerox at its Palo Alto, California Research Center in 1973.

SCSI (Small Computer System Interface) – a method of connecting peripherals to a PC system. According to Conventional scheme requires separate expansion board for each peripheral unit, but SCSI allows you to link up several units "along a single line in a daisy-chain network...[SCSI is] like a multi-lane turnpike, compared with the cables in a conventional system, which are more like two-lane roads." SCSI was standardized as a set of specifications for physically connecting and transferring data across platforms in 1986.

The definitions above paraphrase entries in the following computer glossaries:

- Edwards, Robert A., ed. *The Prentice-Hall Encyclopedia of Information Technology*. Prentice-Hall: Englewood Cliffs, NJ, 1987.
- Galland, Frank J. *Galland Dictionary of Computing*. John Wiley & Sons, New York: 1982.
- Gibilisco, Stan, ed. *The McGraw-Hill Encyclopedia of Personal Computing*. McGraw-Hill: New York, 1985.
- Tindell, Larry D. "Microcomputer." *Computer Science Sourcebook*.

III. Concepts:

Vertical integration and competition with IBM –

For most of the period covered in this timeline, Apple production was vertically-integrated; Apple-authored hardware and software come pre-installed on the computers. Between 1977 and 1981 (when the first IBM-compatible PC was introduced), this was a very profitable arrangement for the Apple. However, throughout the 1980's, Apple was outsold by IBM-compatible PCs, which were produced and packaged differently (one vendor provided the operating system and multiple third-party vendors created the software). Apple's vertical integration made it impossible for non-Apple software designers to create software for the product. MS-DOS, the operating system of IBM-compatible computers, was open for third-party designers to utilize. As a result, far more software applications were available for IBM-compatible computers than Apple computers. Apple's market share suffered as a result, and invited third-party vendors to participate in the creation of software for the Mac in 1984.

Apple brand identity- Apple built its brand reputation on ideals of innovation, aesthetics, and simplicity of use verging on the intuitive. Through strategic marketing, Apple invented the idea of the "computer connoisseur," an enlightened layperson who cares more about quality of design and performance than about price. It styled itself and its products as individualistic, personal, young and cutting-edge. The company also made a considerable effort to portray its corporate image as "less corporate" than IBM's. Steadfastly dedicated to its original marketing techniques, Apple outlived the market-

dominating entity IBM and has grown substantially through the first decade of the 21st Century.

Early portable computers – The late 1980's ushered in the age of portability. During this period, with the Apple grappled with the logic of portable computer design: Which features of a regular computer are extraneous for a portable computer? What does a traveling computer need that a regular computer does not have? How should it be powered? These questions pertained especially to the Apple IIc and the Mac Portable.

IV. Additional Reading

Allan, Roy A. *A History of the Personal Computer: The People and the Technology*. Allan: Ontario, Canada: 2001.

Linzmayr, Owen W. *Apple Confidential*. No Starch: San Francisco, 1999.

Moritz, Michael. *The Little Kingdom: The Private Story of Apple Computer*. William Morrow: New York, 1984.

1973

Xerox PARC Alto

The first PC

As originally conceived, a "personal computer" was a microcomputer designed to be operated by a single person. Until the mid-1980's, the term "PC" was specifically reserved for business computers, as home computers were generally assembly-kit machines used for video games or hobby programming.

Xerox created the first PC At its Palo Alto Research Center (PARC) facility in 1973 and called it the Alto. Though the it was never sold to the public, its revolutionary technology set the course for the way computers look and operate today, introducing the graphical user interface (GUI). The GUI did away with typed commands in favor of a "point-and-click" configuration that allowed users to select options from pop-up menus and icons, and to view information on the screen via overlapping windows and scroll bars. It was also the first computer to use a mouse, bit mapping for graphics, ethernet (allowing multiple computers and printers to communicate) and an object-oriented programming language with reusable, self-contained models of code.



(Prentice-Hall Encyclopedia of Information Technology p. 325; Linzmayer, Owen. Apple Confidential: The Real Story of Apple Computer, Inc. pp.51-55; photo: Shustek, Len. "A Walk Through 'Visible Storage,'" The Computer History Museum online. Accessed 10/2007 at <http://ed-thelen.org/comp-hist/Shustek/ShustekTour-05.html>)

1975 Altair 8800

The first kit computer to feature a microprocessor

MITS, an Albuquerque-based company, designed the Altair 8800, the first computer sold to the public to feature Intel's 8080 microprocessor chip. Discussing the Altair's use of the microprocessor, computer historian Michael Moritz writes,

"the conceptual framework for the microprocessor corresponded with the ideas that lay behind all digital electronic computers produced after World War II. The Electronic Numerical Integrator and Computer, IBM's 1130, Varians' 620i, Digital Equipments's PDP-8 and Data General Nova all used the same principles as the Intel 8080. The only difference was the size. The thirty-ton ENIAC with all its eighteen thousand vacuum tubes was less powerful than the Intel 8080 which, with its five thousand transistors, could be swallowed."



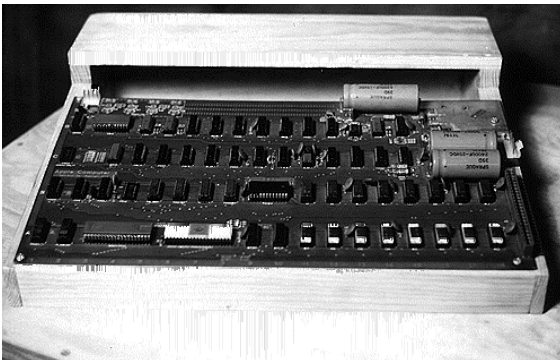
The Altair was not a PC, but a basic kit computer that had to be assembled—with extensive soldering—and did not include any input/output (I/O) devices for its retail price of \$375. It was prone to overheating and needed additional equipment, such as a monitor, keyboard, and extra boards of memory chips, to do anything useful. Still, it represents a significant milestone in the history of computing, because it made the sophistication of the microchip accessible to amateur and professional programmers.

(Moritz, Michael. The Little Kingdom, p.106; image: Concordia University Computer Museum online, accessed 10/2007 at <http://www.cs.cuw.edu/csc/csc175/project/remeza/history.html>)

1976

Apple I designed; Apple founded

In 1976, Steven Wozniak and Steven Jobs completed a prototype for the original Apple circuit board. Jobs selected the MOS Technology microprocessor, essentially a knock-off of the Motorola 6800, a competitor of the Intel 8080. The Apple I was designed as a kit computer and did not include a case, power supply, monitor or keyboard.



Processor: 8-bit MOS Technology 6502 at 1MHz
Memory: 8K RAM (expandable to 32K)
Storage: Tape-interface sold separately
Dates of production: 1976

Cost: \$666

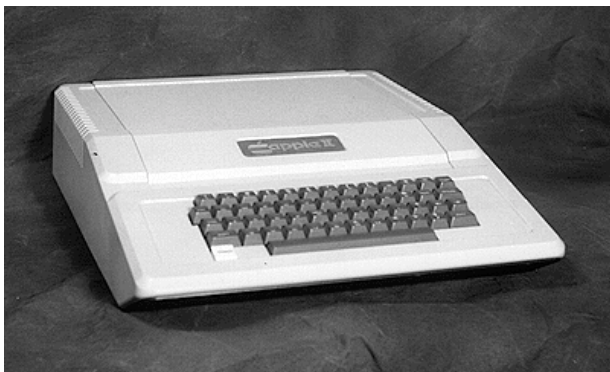
Also that year, Jobs demonstrated the Apple I to computer-retail entrepreneur Paul Jay Terrell, who in turn contacted Jobs to build 50 fully-assembled computers incorporating the Apple board at \$500 each. To accomplish this task, Wozniak, Jobs, and Ronald Wayne founded Apple Computer.



A custom-built case for the Apple I, now housed at the Smithsonian Institution

(Linzmayr, Owen. Apple Confidential: The Real Story of Apple Computer, Inc.; Moritz, Michael. The Little Kingdom; photos: Shustek, Len. "A Walk Through 'Visible Storage,'" The Computer History Museum online. Accessed 10/2007 at <http://ed-thelen.org/comphist/Shustek/ShustekTour-05.html> and "Apple I," Wikipedia. Accessed 10/2007 at http://en.wikipedia.org/wiki/Apple_I)

1977 Apple II



The Apple II added a plastic case to the Apple I. Jobs suggested housing the computer in a smooth-edged plastic case to make it more aesthetically pleasing than IBM's sheet-metal boxes. The case, which had a removable lid, was designed to be just large enough to and accommodate expansion cards into the motherboard and ventilate the machine so that it wouldn't overheat.

Industrial computer manufacturers were in the process of developing disk drive technology to replace the reels of magnetic tape previously used to store information. The original design for the Apple II called for a cassette tape hooked up to a microcomputer rather than open-reel tape. Wozniak began exploring IBM's floppy disk (invented in 1972) and worked with the Shugart company of Silicon Valley to create a disk drive and disk operating system, Apple DOS, for the Apple II. The computer had a command-driven interface (the Apple II product line would not feature a graphical user interface for another ten years) and utilized the Integer BASIC programming language.

In April, 2007, *PC World* ranked it #2 in its survey "The 50 Best Tech Products of All Time," noting that,

"while the original Apple I computer was really just a hobbyist's diversion, the Apple II was a computer for Everyman. Beating the IBM PC 5150 to market by four years, the Apple II (and its cousins, the II+, IIe, and IIfx) quickly became the computer for people who wanted a machine that actually did something...It offered plenty of productivity tools (it was the first PC to run the VisiCalc spreadsheet, for instance), it was good at gaming, and it was quite extendable (when is the last time you saw a computer with eight expansion slots?)."

Processor: 8-bit MOS Technology 6502 at 1MHz
Memory: 4K RAM (expandable) 12K ROM
Dates of production: 1977-1980
Storage: disk drive (initially optional, but came standard by 1978)
Degree of Expandability: high (8 slots)
Cost: \$1298



Apple II with two 5.25" floppy drives and monitor

In 1979, Apple introduced the Apple II Plus, which was almost identical to the Apple II, but it offered significantly more RAM and introduced a new, Microsoft-authored programming language called Applesoft BASIC. This dialect of BASIC became the standard language for the Apple II series.

Processor: 8-bit MOS Technology 6502 at 1MHz
Memory: 48K RAM (expandable to 64K) 12K ROM
Dates of production: 1979-1983
Storage: 5.25" floppy drive
Degree of expandability: high (7 slots)
Cost: \$1995

(Moritz Michael, *The Little Kingdom* pp.186-87; Linzmayer, Owen. *Apple Confidential*. p.293; *PC World*, "The 50 Best Tech Products of All Time" April 2, 2007 Accessed 10/2007 at <http://www.pcworld.com/article/id,130207-page,2-c,technology/article.html>; "Apple II Series" Wikipedia. Accessed 10/2007 at http://en.wikipedia.org/wiki/Apple_II)

1980

Apple III



Apple sustained great success with the Apple II, but the company knew IBM would soon enter the PC market. They also knew that their next ambitious PC project, a business machine codenamed Lisa, would not be ready for several years. The Apple III was intended as a "stopgap product" to bridge the two products without losing its customer base to IBM. The Apple III was intended to target small businesses, shifting the Apple II's target to home and school use and preparing a space in the large business market for the Lisa.

Designed by committee (rather than by Wozniak) and shipped before its software was ready, the Apple III was a disaster. Design flaws caused the computer to overheat and

crash, and the built-in clock, one of its major selling points, was unreliable at best. The computer was advertised as compatible with Apple II programs, but major bugs surfaced in this area as well. Apple secrecy about technology-in-development made it impossible for outside software companies to design better software. On the positive side, the Apple III introduced some important features, such as a hierarchical file system, a numeric keypad, and uppercase and lowercase capability. It had a new operating system called SOS (Sophisticated Operating System) built-in Apple Business BASIC and Pascal programming languages. For \$4,500 Apple III included a black-and-white monitor, dot-matrix printer and the VisiCalc spreadsheet program.

Apple announced the new model at the 1980 National Computer Conference with much fanfare, renting out Disneyland for an evening to entertain 7,000 conference-goers in celebration of the unveiling. Once the Apple III hit stores, however, customer reception was less than exuberant. Although the company made significant improvements on the Apple III in subsequent versions such as the Apple III Plus, the product line's reputation never improved, and Apple discontinued it in 1984.

Processor: 8-bit Synertek 6502A at 2MHz
Memory: 95K RAM (expandable to 128K), 4K ROM
Dates of production: 1980-1985
Storage: built-in 5.25" 143K floppy drive
Degree of Expandability: medium (4 slots)
Cost: \$4,500

The Apple III Plus, introduced in 1983, fixed most of the hardware problems of the infamous Apple III (offering a functional built-in clock, for instance) and improved the ports and card slots of its predecessor. Still, it sold poorly, and Apple discontinued the Apple III line in 1984.

(Moritz Michael, *The Little Kingdom* p. 293; Linzmayer, Owen. *Apple Confidential*; Allan, Roy A. *History of the Personal Computer*. p. xxv)

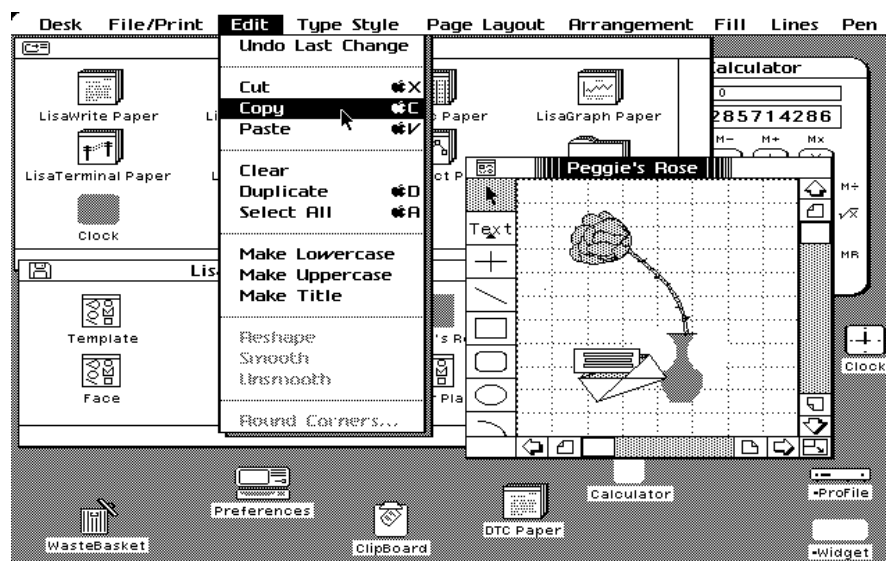
1983

Lisa



In 1979 Steve Jobs made several visits to Xerox PARC and was intrigued by the Alto's use of GUI. Popular lore suggests that Jobs stole ideas from Xerox, but in actuality he furnished Xerox with a healthy stake in Apple in exchange for information. Although Lisa borrowed many features from the Alto, Lisa included several novel additions.

The original specifications called for a \$2000 computer that contained a graphical user interface, mouse, LAN, file servers, and new software. The final product had these features but was far more expensive. From the XEROX Alto, Apple borrowed pop-up menus, overlapping windows and scroll bars. Lisa first introduced menu bar, pull-down menus, one-button mouse, cutting and pasting with the clipboard and the trash can.



The Lisa originally came with bundled applications: spreadsheet, drawing application, graphing program, searchable/sortable database program, file manager, project manager, terminal emulator and word processor. It also came with AppleNet, networking software that allowed multiple Lisa installations to be connected to printers and each other. The initial cost of nearly \$10,000 was too expensive even for the high-end business user, so Apple unbundled the software later in the year to lower the price to

\$6995. Aiming a computer at larger businesses for the first time, Apple had trouble marketing in competition with IBM. The Lisa was too complex, too expensive and many users complained its twin 5.25" floppy drives were too slow.

The Lisa introduced a new chip, the Motorola 68000, which would be used in most Macintosh computers for the next decade. At the unveiling ceremony for Lisa, Steve Jobs made the mistake of telling reporters that Apple would soon announce a computer that offered many of Lisa's features for only \$2,000, and that the new, cheaper computer and Lisa wouldn't be compatible. This slip on Job's part, as well as the doomed existence of the Lisa product line as a whole, paved the way for the success of the Macintosh. The Mac, introduced a year later, benefited directly from the prestige of the unattainable Lisa, offering similar features for a fraction of the price.

Processor: 16-bit Motorola 68000 at 5MHz

Memory: 1 MB RAM

Dates of Production: 1983-1985

Storage: two 5.25" 871KB floppy drives, external 5MB hard drive

Cost: \$9,995 (later \$6995)

(Linzmayr, *Apple Confidential* pp.51-61; Allan, Roy A. *History of the Personal Computer*; photos: <http://www.macgeek.org/museum/applelisa1/>; <http://www.digibarn.com/collections/systems/apple-lisa2xl/index.html>)

1983

Apple IIe

The Apple IIe ('e' stood for enhanced) was Apple's longest-lived computer model. It introduced the ASCII character set, improved the previous Apple II keyboard, and added a mouse. It used fewer chips and thus made the motherboard cooler and cheaper to build. The Duo Disk, a case with two 5.25" floppy drives designed to stack between the computer and the monitor, was sold separately.



Processor: 8-bit MOS Tech 6502 at 1MHz
Memory: 64K RAM (expandable to 1MB) 32K ROM
Dates of production: 1983-1993
Storage: optional twin 5.25" floppy drives
Operating system: Pro Dos
Cost: \$1,290 (1,390 with Duo Disk and monitor)



Apple IIe with Duo Disk and monitor

(Moritz, Michael. The Little Kingdom; Allan Roy A., History of Personal Computing. xxxi-xxxii: photos: "Apple IIe," Wikipedia. http://en.wikipedia.org/wiki/Apple_IIe; http://www.zock.com/8-Bit/D_Apple-IIe.HTML)

1984 Macintosh

In the words of Mac designer Jef Raskin, "Apple II is a system. Macintosh is an appliance." Raskin wanted to create a computer for the average consumer, which could be operated without spending much time reading a manual. The original Mac was the first affordable personal computer to feature a menu-driven, graphical user interface. It also came with a built-in monitor, keyboard, mouse, and a more compact 3.5" floppy drive. With its 16-bit microprocessor running at 8MHz, the Macintosh could process 10 times as much data in a given period as the Apple II, and used fewer chips. It was smaller, cheaper and faster than the Lisa and came bundled with MacPaint, MacWrite and the Finder. Learning from the software fiasco of the Apple III, the company shared information about the Mac with a selected group of third-party software publishers prior to the computer's release.



Critics of the Mac complained of its small memory—only 128K of RAM—and its lack of expandable, open architecture, which was seen as an asset of the Apple II.

The Mac offered many design concepts of the Lisa in an affordable and simplified form, making it far more marketable. To introduce the Mac, Apple hired Ridley Scott to direct the "1984" Superbowl commercial, which advertised the computer as a spirited and liberating alternative to the stodgy, "impersonal" IBM-compatible PCs.

Processor: 16-bit Motorola 68000 chip at 8Mhz
Memory: 128K RAM
Dates of production: 1984-1985
Storage: Sony 3.5 400K floppy drive
Display: 9" monochrome
Cost: \$2495

Later in 1984, Apple released a Macintosh with twice as much RAM, called the Mac 512K (the original Mac then became known as the 128K). The 512K retailed for \$3195 and was produced until 1986.

(Moritz Michael, *The Little Kingdom* p. 129; Linzmayer, Owen. *Apple Confidential*, p.75; Allan, Roy A. *History of the Personal Computer*. p. xxv; photo: "Apple Macintosh," Wikipedia. Accessed 10/2007 at http://en.wikipedia.org/wiki/Apple_Macintosh)

1984-85

Lisa 2 series

Lisa 2, Lisa 2/5, Lisa 2/10

Responding to slow sales of the Lisa, Apple released three additional versions for half the price of the original, the Lisa 2, the Lisa 2/5 and the Lisa 2/10 (later renamed Macintosh XL). The three computers used the Motorola MC68000 processor and had 512K RAM, and substituted a 3.5" floppy drive for the original Lisa's twin 5.25" drives. All included emulator programs that would allow the Lisas to run Mac application programs and therefore improve their compatibility. Lisa 2 had no hard drive and sold for \$3,495. Lisa 2/5 had an external 5MB hard drive and sold for \$4,495, while the Lisa 2/10 included an internal 10MB hard drive for \$5,495. The Lisa 2/10 was renamed "Mac XL" in 1985, and its price was reduced to \$3,995, but this did not improve sales significantly. Overshadowed by the Macintosh, the Lisa product line was discontinued in 1985.



Lisa 2/10 (a.k.a. MacXL)

(Allan Roy A. xxxi-xxxii; photo: Apple Museum online, accessed 10/2007 at <http://applemuseum.bot.org/>)

1984 Apple IIc

The Apple IIc ('c' for 'compact') was introduced to compete with IBM's PC Jr. (introduced in late 1983). It was built around a modified version of the 65C02 chip that required less power, the Apple IIc was a compact, stripped-down version of the IIe. It had a built-in keyboard, 5.25" 140K floppy drive, speaker and serial interfaces for a printer and mouse. It weighed about seven pounds and could fit into a briefcase. It had no expansion slots and lacked battery power. Its clunky external power supply, dubbed the "brick on a leash," diminished its portability. The IIc came with the new ProDos operating system, which allowed for hierarchical directory structuring, and it was backwards compatible with most Apple II program applications.

Processor: SynerTek 65C02 at 1.4MHZ
Memory 128 kB RAM – expandable to 1MB, 32K ROM
Dates of production: 1984-1990
Storage: 5.25" floppy drive
Cost: \$1295



In 1998, Apple introduced an improved version of the IIc, the IIc Plus, which included a faster version of the 65C02 processor running at 4MHz, a built-in 3.5" disk drive and a built-in power supply, which did away with the brick on a leash. It sold for \$675, or \$1099 with a monitor.

(Moritz, 324; Allan, xxviii; photo:

<http://www.guidebookgallery.org/pics/articles/apple2userinterfaces/apple2c.big.jpg>)

1986 Mac Plus

The Mac Plus the memory of the original Mac to 1MB. It was not expandable but allowed for the connection of an external hard drive. It had a SCSI parallel interface, allowing up to seven peripheral devices to be connected to the computer at once, and added a numeric keypad and cursor keys to the original Mac keyboard. MacPaint and MacWrite came bundled with the Plus, and new software was increasingly available as Macintosh invited third-party designers to introduce compatible programs. Its 800K floppy drive was also backwards-compatible with the 400K floppies of the previous Macs.



Processor: 16-bit Motorola 68000 chip at 8Mhz
 Memory: 1 MB (expandable to 4MB)
 Dates of production: 1986-1990
 Storage: 3.5" 800K floppy drive
 Expandability: none

Cost: \$ 2,599

(Allan, xxxix; photo: http://www.thepcmuseum.net/comp_images/photo_applemacpluslg.jpg)

1986 Apple IIGS

The Apple IIGS combined the technology of the Apple II line with the Mac by incorporating a GUI. Additionally it expanded graphic resolution and sound functions of the previous models ("GS" stood for "graphis and sound"). It introduced the Apple Desktop Bus (ADB) Port for hooking up a keyboard and a mouse and had a SCSI adapter card. One of the most attractive features of the IIGS was that it was almost fully backwards-compatible and could run the earlier Apple II programs and operating systems.



Processor: Western Design Center W65SC816 chip at 2.8 or 1MHz
Memory 256K RAM (expandable to 8MB) 128K ROM (expandable to 1MB)
Dates of production: 1986-1992
Storage: 5.25" 140K floppy drive and/or 3.5" 800K floppy drive
Cost: \$1500 (with monochrome monitor)

(Allan, Roy A. p. xxx; Photo: <http://oldcomputers.net/appleiigs.html>)

1987 Mac II

The modular design of the Mac II was a departure from the previous compact Macs, and it made the computer look more like an Apple II or an IBM-compatible PC. It was introduced as a second-generation Mac for more advanced users, offering open architecture with several expansion slots. One available expansion card featured color graphics, making it the first color-capable Mac. It had a 32-bit microprocessor, built-in hard drive, and the ability to network with IBM computers. It included Apple Desktop Bus and SCSI ports. The "fully loaded" system, with a 40MB hard drive and color monitor, sold for \$7044.



Processor: 32-bit Motorola 68020 chip at 16Mhz
Memory: 1 MB (expandable to 20MB)
Dates of production: 1987-1990
Storage: 3.5 800K floppy drive, optional 40MB hard drive
Cost: \$3,898-\$7,044

Apple introduced another version of the Mac II in 1988, the Mac IIx. It used a coprocessor for additional speed and retailed at \$7,769.

(Allan, Roy A. p.xxxix; photo: "Macintosh II," Wikipedia. Accessed 10/2007 at http://en.wikipedia.org/wiki/Macintosh_II)

1987 Mac SE

Released concurrently with the Mac II, the Mac SE ("System Expansion") kept the all-in-one, compact look of the original Mac but offered one internal expansion slot. Targeting the small business market, it was about four times slower than the Mac II but half the price. It contained two internal 3.5" 800K floppy drives, an improved power supply, and an internal cooling fan. It was SCSI-compatible and its ADB port accommodated up to 16 input devices.



Processor: 16-bit Motorola 68000 at 8MHz
Memory: 1MB (expandable to 4MB)
Dates of production: 1987-1989
Storage: two 3.5" 800K floppy drives, up to 40 MB hard drive
Cost: \$2,769

(Allan, Roy A. xl; photo: "Macintosh SE," Wikipedia. Accessed 10/2007 at http://en.wikipedia.org/wiki/Macintosh_SE)

1989 Mac Portable



Too large to fit on an airline tray table and weighing in at almost 16 pounds, the Mac Portable was deemed "luggable" by critics. Its heft was due in part to its acid-lead battery (the same type used in cars) and also to feature overload. It contained a full-sized keyboard, a trackball mouse, sound output, optional internal 40MB hard disk, and an active-matrix screen. Apple hoped that the screen would be a major selling-point—"active matrix" meant that each pixel was controlled by its own transistor, dramatically improving clarity of display—but the lack of a backlight made it nearly impossible to read in low-light situations. It was too large to fit on an airline tray table and the screen was difficult to see under anything but the bright fluorescent light of an office. Here Apple learned that when it comes to portable computers, less is indeed more.

(Linzmayr, Owen W. *Apple Confidential*; Moritz, Michael. *The Little Kingdom*; photo: <http://oldcomputers.net/pics/macportable.jpg>)

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