The Graphical User Interface

The GUI, or Graphical User Interface, is how we use most digital devices, from desktop computers to mobile phones. Typical GUIs allow organizing documents and applications in hierarchical windows and folders, and have icons that can be clicked to launch applications and to open documents. These interactions are done with a mouse, track pad or touch screen.

The Macintosh operating system interface.

The development of the GUI, which started about 40 years ago in the 1980s, had several effects:
• It popularized personal computers with the general public by making them easy to use.
• It made it possible to display on a computer screen images such as photos and graphics and to play media such as video and audio files.
• It made it possible to use PCs to create and edit publications, digital images, graphics, video and audio.
• It provided the user interface for web browsers, popularizing the Web in the 1990s.

As a result, the GUI transformed both the production and consumption of media, shifting entire industries from analog to digital methods, resulting in profound cultural changes and impacts on how we communicate and interact with each other, how we work, and how we shop, entertain ourselves and otherwise spend our time.
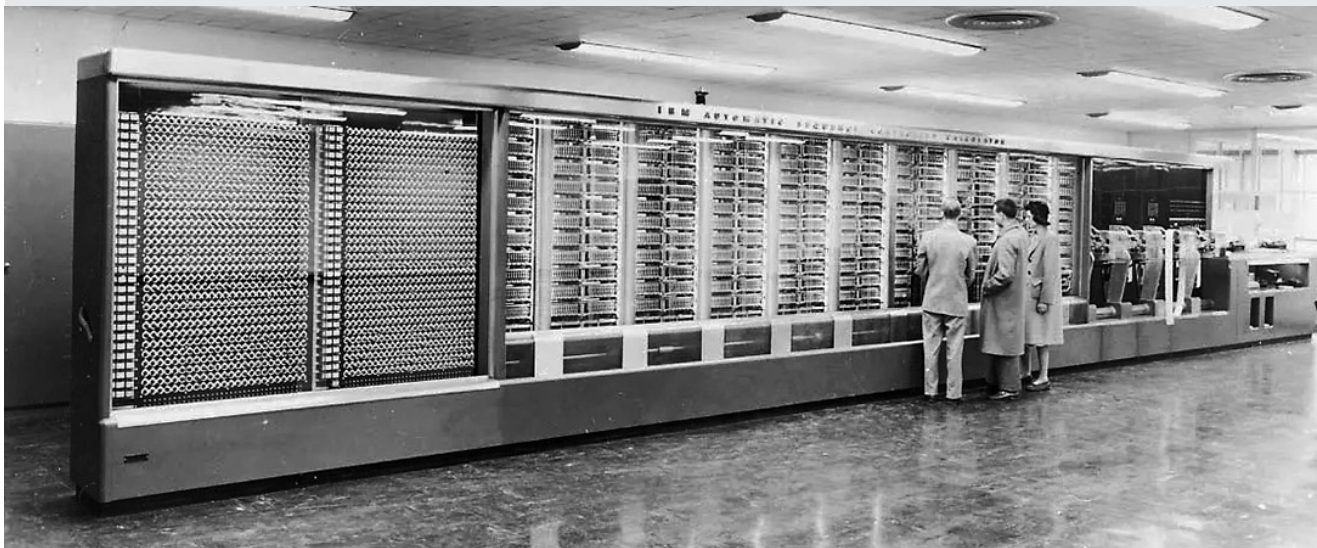

The Apple iPhone interface.

1937

The **Harvard Mark I,** the first electronic computer.

The **first computers** were never intended to be communication and entertainment devices. Their purpose was as their name implied, to perform complex and time-consuming mathematical calculations.

The first electronic computer, the **Harvard Mark I**, was built by IBM in 1937, designed by Howard H. Aiken, a Harvard graduate student. It was 51 feet long and weighed close to five tons, and required 530 miles of electric wire. Commands were entered with punch tape, and the output was typed automatically by two typewriters.

It was referred to as an automatic calculator, or more precisely the Automatic Sequence Controlled Calculator, or ASCC. The term computer wouldn't come into common use until 1945.

Before the GUI would have a practical use, computers had to become compact and affordable. This required some considerable improvements over the first electronic computers, which were room-sized and weighed several tons. The two key innovations that made this possible were **transistors** and **integrated circuits**.

Transistors

Obviously this first computer would not be accessible to the general public or capable of the communication tasks that we use PCs for today. The first innovation in making them more practical was the invention of transistors, which replaced the vacuum tubes that were used until then for the task of controlling electricity. William Shockley, Walter Brattain and John Bardeen created the first transistor in 1947 at Bell Laboratories in New Jersey (Bell Labs is a subsidiary of AT&T). For this they were awarded the Nobel Prize in Physics in 1956.

Integrated circuits

Another key development was the invention of the integrated circuit, which

combined all the electronic components on a typical circuit board, such as transistors, capacitors (a passive component to store a small electric charge), resistors and the like, into a single compact unit. The first one was designed in 1958 by **Jack Kilby** of Texas Instruments, based on a concept by **G. W. A. Dummer**, an English engineer. This made it possible to design and build much more compact electronic devices.

In 1968 the Fairchild Semiconductor company developed the first **microprocessor chip**, a single integrated chip that performed all the central operations of a computer, also called a central processing unit or **CPU**. These would become the heart of not only computers but of all digital devices to come.

1947

Transistors are made of a semiconductor material, most commonly silicon. They are used to control the flow of electricity, both by turning a current on and off and by controlling the current's strength.

A semiconductor will conduct electricity only when a small, secondary electric current is applied to it.

There are different types of transistors for different purposes. Some retain a charge even when power is turned off, serving as memory.
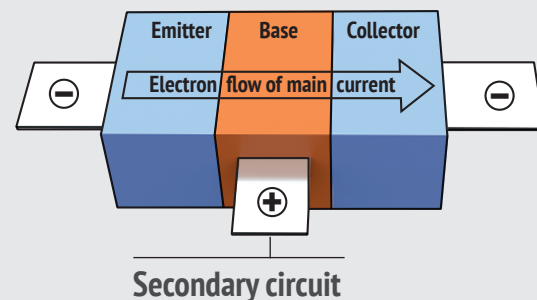

Secondary circuit

When the secondary circuit is off, the main current is blocked. When turned on, the base becomes a conductor, allowing electrons to flow through it at increasing rates as the secondary circuit's strength is increased.

1958

Integrated circuits, also called microchips, combine transistors into one unit on a piece of semiconductor material. By doing so it greatly reduces the size of circuitry for electronics, with billions of microscopic transistors on flat chips just a few inches across. PC's and mobile devices wouldn't be possible without these.

Current manufacturing methods etch the circuits using a photo-lithographic process, literally printing circuit boards with transistors just a few nanometers long (a nanometer is one billionth of a meter. A human hair is
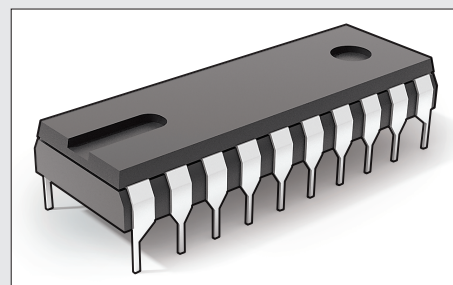
about 100 thousand nanometers wide).
The CPUs used in Apple's iPhones have up to 19 billion transistors. The largest integrated circuits have up to 2 trillion transistors.

First PCs

These innovations made it possible to make the first personal computers, or PCs, that would be marketed to the general public. The first commercially successful one was the the **Altair 8800**, built by **MITS** (Micro Instrumentation and Telemetry Systems). It went on the market in 1975, for sale as a mail-order kit for $397 (a little over $2,300 in 2024). It sold well above expectations, primarily to hobbyists.

The Altair was operated with toggle switches and the output was through indicator lights, both of which were on the front panel. With additional hardware it could be connected to a TV and a printer. Its operating system, PC-DOS, was created by aspiring programmers **Bill Gates** and **Paul Allen**. Based on this, their first project, Gates and Allen founded **Microsoft**, which they originally spelled 'Micro-Soft', intended to stand for 'Microcomputer Software.'

The Altair's success inspired dozens of entrepreneurs to enter the new personal computer market. Two of these were **Steve Jobs** and **Steve Wozniak**, who founded **Apple Computer** in 1976 with the release of

the Apple I. This was followed by the more complete Apple II in 1977, which had a built-in keyboard for input and could be connected to a monitor, making it a precursor to modern desktop computers.

Apple II sales were boosted by a new kind of software, **VisiCalc**, coded by Dan Bricklin, a Harvard Business School student, in 1979. It was the first spreadsheet for personal computers, and justified the cost of the computer for business use.

IBM, which up till now was only making mainframe computers, developed their first PC, the **IBM 5150**, in 1981. It used Microsoft's DOS operating system. Its affordability and range of software allowed it to dominate the market, which also led to Microsoft's dominant position in PC software.

But all of these early machines relied on typing commands on a keyboard. The first commercially successful GUI computer was released by Apple in 1984: **The Macintosh**. It had a display with windows and icons which could be clicked with a mouse, making it easy to operate.

1975

The Altair 8800 Computer with an 8-inch floppy disk drive. This was the first commercially successful personal computer, which used the first Microsoft operating system.
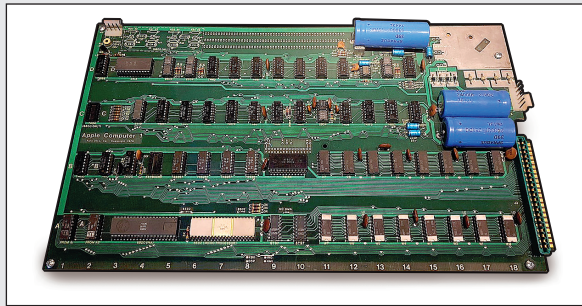

Michael Holley / Creative Commons

Apple computers

1977

1976

Arnold Reinhold / Creative Commons

The Apple I was sold as a circuit board without a case. The buyer had to connect it to a keyboard and TV.

FozzTexx / Creative Commons

The Apple II came in a molded case with built-in keyboard, and two game paddles. The monitor and cassette recorder, used to load software and save data, were extra.

1981

The IBM 5150. In 1980 IBM began development on their first personal computer, and a year later released the 5150, built largely with outside vendor parts including the Intel 8080 CPU chip, and using PC DOS, an operating system from Microsoft. It cost $1,565.

It was operated entirely by typed-in keyboard commands. Its interface consisted of rows of green characters displayed in a 12" monochrome monitor. The IBM 5153 13" monitor had color.
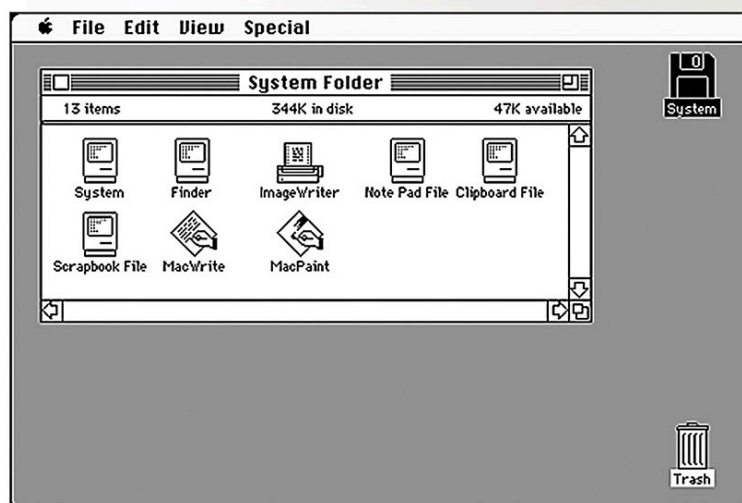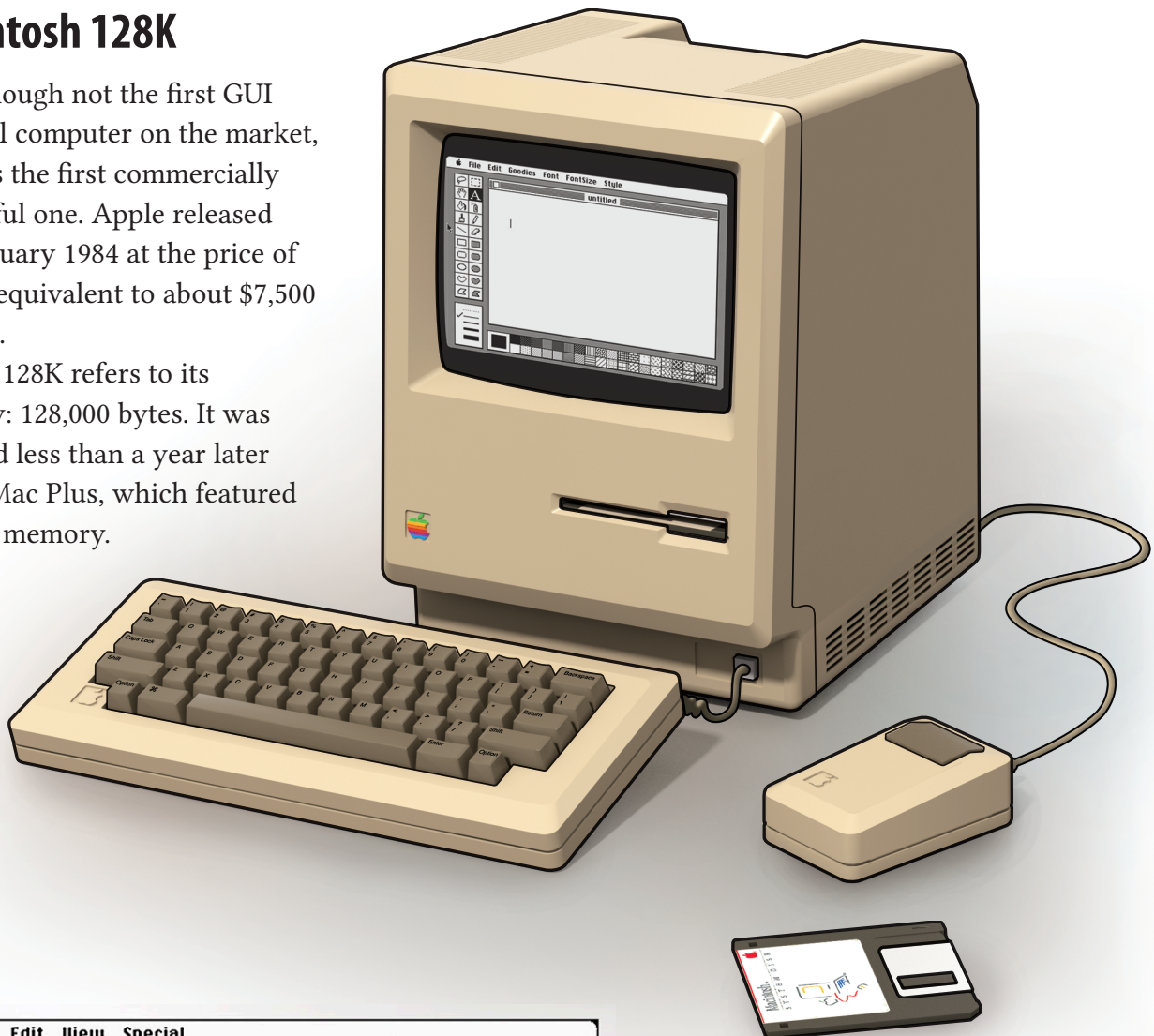

dosdays.co.uk

1984
Macintosh 128K

Although not the first GUI personal computer on the market, this was the first commercially successful one. Apple released it in January 1984 at the price of $2,495 (equivalent to about $7,500 in 2024).

The 128K refers to its memory: 128,000 bytes. It was followed less than a year later by the Mac Plus, which featured 512K of memory.

The Macintosh interface with a window, icons for files and a menu bar at the top. The System disk holds the operating system needed to start up the computer.

This was a true graphical user interface. The mouse was used to move icons and windows around, to resize the windows, and to open documents and launch applications by double-clicking on their icons.
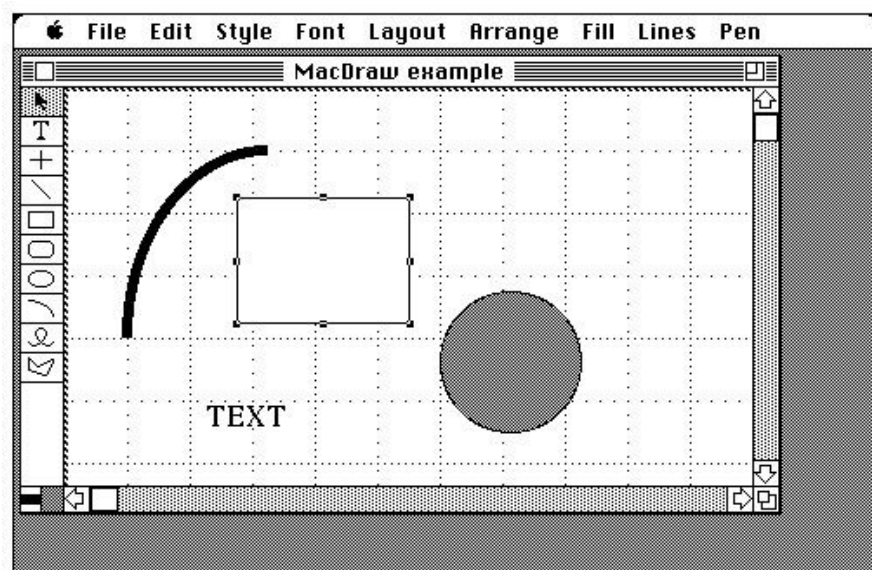
Applications

With the new Macintosh operating system, and with Microsoft's release of the first version of Windows in 1985, new software taking advantage of the GUI quickly came on the market. The Macintosh came with two applications for creating graphics, MacDraw and MacPaint. These were precursors to the range of graphics and publication applications that are available today, such as the **Adobe** Corporation's Photoshop, Illustrator, and InDesign.

The GUI allowed desktop computers to take over the tasks of creating visual content and designing print documents, and with the populatization of the web in the 1990s, creating and distributing digital content.

MacDraw was one of the first digital applications for creating graphics on a PC. It is in a class of software called **Vector**, in which shapes are defined by anchor points connected by paths. The anchor points are created with a tool controlled by a mouse or trackpad. It was a precursor to Adobe Illustrator.

MacPaint was another application that emulated traditional art media. It belongs to a class of software called **Bitmap**, or **Raster**, in which images are defined by rows of different-colored pixels. It was a precursor to Adobe Photoshop.

Technology Timeline

EARLY TECH	**1937**	**First electronic computer,** the Harvard Mark I.
	1947	**Transistors** are invented.
	1958	**Integrated circuits** are invented.
INTERNET	**1962**	**DARPA** (Defense Advanced Research Projects Agency) proposal for computers to exchange messages over the existing telephone network.
	1969	**ARPANET** is launched: First successful exchange of messages between two computers, one at UCLA and one at Stanford University in California. This is the start of the Internet.
DESKTOP COMPUTERS AND GUI	**1975**	**First PC:** Altair 8800. First commercially successful personal computer. **Microsoft** is founded; provided operating system for the Altair.
	1976	**Apple Computer** is founded, with release of Apple I, followed by Apple II in 1977.
	1981	**IBM** releases the 5150 desktop PC, with Microsoft DOS operating system. It dominates the market, as does Microsoft software.
	1984	**Macintosh 128k** is released by Apple, the first commercially successful GUI PC.
	1985	**Windows OS** is released by Microsoft, their first GUI operating system.
WORLD WIDE WEB	**1990**	**Start of the World Wide Web**, with Tim Berners Lee's release of the HTML coding language; and the public is given access to the Internet.
	1993	**Mosaic:** First web browser to be widely adopted.
	2004	**Facebook** launched: Start of social media era.
	2008	**iPhone** launched: Start of mobile device dominance. Android phones come on the market in 2009, iPad in 2010.