- Computers

TECHNOLOGY

HOW PC DRIVES EVOLVED

Modern computer drives can store the equivalent of hundreds of high-resolution movies over a century since their humble origins

WORDS BEN BIGGS

When do you think the first data storage device was invented? Maybe around 50 years ago, alongside the first personal computers? Or 80 years ago, around the time the first transistor was invented? It's much earlier than that: US inventor Herman Hollerith popularised the first machine data storage medium in 1890, when it was used to help process data in the US census that year. Punched cards were composed of round holes in pieces of machine-readable cards, punched in precise places that corresponded to a data point. These data cards were fed into Hollerith's electric-powered punched card tabular, which would rapidly calculate and tally all the data. In the case of the 1890 US census, this included categories such as the age, gender, and number of people in a household. Hollerith's invention helped reduce the time it took to process census data from eight years to six years, even though punched cards weren't used for all parts of the census.

Did you know?

The Apollo 11 guidance computer had a 32-kilobyte hard disk

In the following decade, the punched card tabulator was licensed to other countries for their own censuses. And over the next 70 years, many other industries benefited from his machine, where the automated process of calculating huge amounts of data on reams of punched cards, as opposed to the tediously slow hand-counting of yesteryear, saved weeks of working hours and millions of dollars.

Hollerith died in 1929, but not before he sold his Tabulating Machine Company and saw it merged into what would become International Business Machines in 1924, a company you might know better by its initials: IBM.

IBM continued to develop its acquired punched card machine technology, moving to square-hole cards in the 1930s that could hold more data until more modern data storage devices such as magnetic tape and disk drives arrived in the late 1950s. These new storage media not only held more data, but they were read at a much faster rate by early computing devices than punched card tabulators, and they also saved a lot of physical space compared to the huge archives of punched cards. Electronic data storage and computers led directly to the information age of the late 20th century, with disks, disk drives and memory chips whose capacity and read-write speeds Hollerith couldn't even have dreamt of – although these owe an awful lot to a simple bit of card with a few holes punched into it.



The IBM System/370 Model 115 launched in 1973. Up to four drives could be attached for a total storage capacity of 280 megabytes

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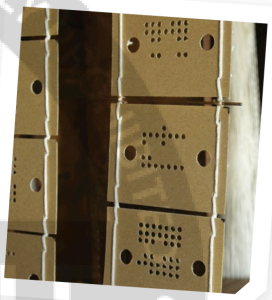
DID YOU KNOW? The world's first hard drive weighed over a tonne and had a 3.75-megabyte capacity

1804

The Jacquard loom was patented over 200 years ago. This textile-making machine used a chain of punched cards for different patterns.



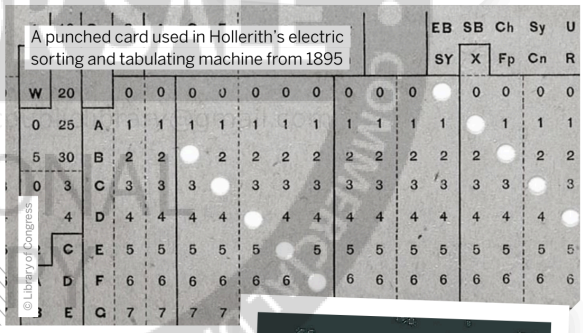
Punched cards were laced together in different sequences, depending on the pattern required

1884

Inspired by the 'programmable' looms of the early 1800s and punched train tickets, Hollerith invented and patented the punched card tabular machine.

1924

The International Business Machines Corporation was founded, going on to become a major player and innovator in the computing and data storage industry.

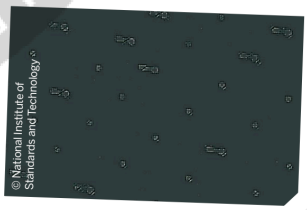


A punched card used in Hollerith's electric sorting and tabulating machine from 1895

© Library of Congress

"These data cards were fed into Hollerith's electric-powered punched card tabular"

1947



© National Institute of Standards and Technology

These dots and dashes were displayed for less than a second on the surface of a Williams-Kilburn tube

Not long after the first commercial television sets were available, a novel use for cathode ray tube (CRT) technology was envisaged by British computer scientists Freddie Williams and Tom Kilburn. While computers of the time could process data at an unprecedented speed, they were held back by clunky mechanical memory. Williams and Kilburn developed the first entirely electronic memory device, which could store 512 to 2,048 bits of data as dots and dashes on the surface of a screen, projected by a CRT. These disappeared after just a fraction of a second, so they had to be continually refreshed while being read by a metal plate that detected changes in charge at the surface. The Williams-Kilburn tube was a dead end, quickly superseded by magnetic memory storage devices in the early 1950s. But it represented a marked improvement over the punched card system and other forms of mechanical memory, which were showing their age.

DOTS AND DASHES INTO DATA

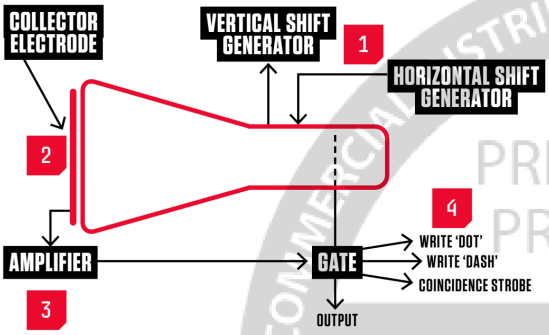
How Williams and Kilburn turned TV technology into data storage

1 DOT POSITIONING
Shift generators determined the position of dots and dashes, representing information.

2 COLLECTOR ELECTRODE
Dots induced a voltage pulse on the surface of a metal pick-up plate, which read the data.

3 AMPLIFIER
Any weak signal was compensated for by an amplifier before the data was sent for output.

4 INPUT AND OUTPUT
Gate circuits controlled dot and dash input to the shift generators, as well as data output.



1952

Cheap and fast mass data storage was made available to early electronic computers with the IBM 726 magnetic tape drive system, which could store up to 2 million digits per tape.

1956

The RAMAC 305 computer ushered in an era of magnetic disk storage with the world's first hard disk drive, which could store 5 million characters across 50 metal platters with a magnetic coating.



A 1956 advert for IBM's RAMAC 305: "Decisions don't have to wait!"

© Alamy / Getty

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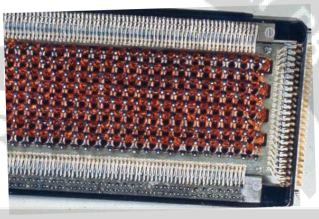
TECHNOLOGY

1969

The Apollo 11 computer that guided astronauts to the Moon contained handmade, read-only rope memory that had around 72 kilobytes of storage. Modern PC drives have tens of millions of times more storage than that.



A program on the Apollo guidance computer's rope memory took months to weave by hand



The Atari VCS' interchangeable cartridges had two kilobytes of ROM for developers to write the final game code onto

1977

Video game developer Atari launched the Atari Video Computer System with an initial nine games stored on cartridges with read-only memory (ROM) chips.

1980

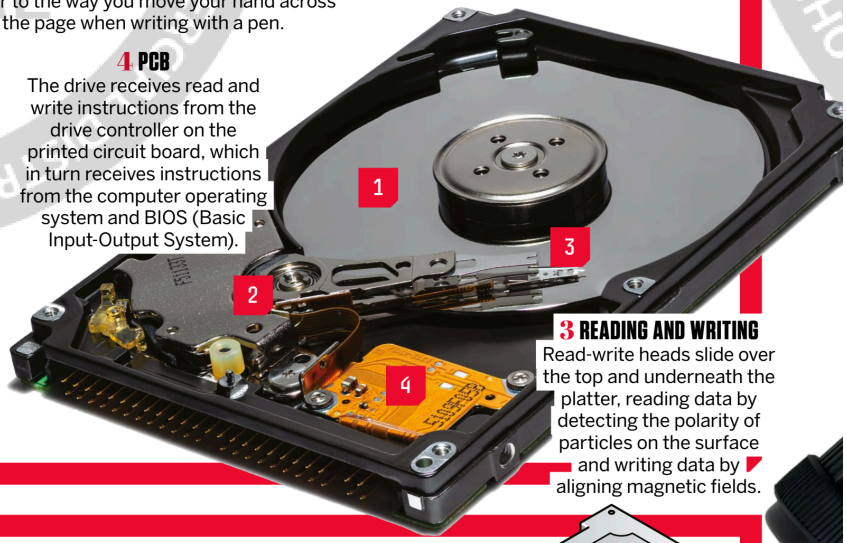
The very first hard disk drive for personal computers was introduced by a US company formed in 1979 that would later be known as Seagate Technology – a major data storage device manufacturer today. The ST506 was the same size as a 5.25-inch floppy disk drive but could hold up to five megabytes of data – over four times the highest capacity 5.25-inch floppy disk. It was composed of an enclosure containing a hard metallic platter – as opposed to flexible floppy disks – that had a magnetic coating on both sides that allowed data to be deleted and overwritten at a rate of 625 kilobytes per second. Seagate attracted prestigious customers like Apple soon after the launch of the ST506, selling over 4 million units within just a few years and becoming the standard internal storage device for personal computers of the time, such as the IBM PC.

1 MAGNETIC SURFACE
Hard disk drive platters are made of aluminium, ceramic or sometimes glass, onto which a magnetic coating is applied, which data is written onto.

2 POSITIONING
A head actuator positions the read-write heads by precisely moving the arm across the platters, similar to the way you move your hand across the page when writing with a pen.

3 READING AND WRITING
Read-write heads slide over the top and underneath the platter, reading data by detecting the polarity of particles on the surface and writing data by aligning magnetic fields.

4 PCB
The drive receives read and write instructions from the drive controller on the printed circuit board, which in turn receives instructions from the computer operating system and BIOS (Basic Input-Output System).



1984

A major breakthrough in data storage media was made in this year: after two years in development, Sony and Philips showed the compact disc (CD) off to the world.

"Electronic data storage and computers led directly to the information age"

1991

The first solid-state drive (SSD), with a capacity of 20 megabytes, was launched by Sundisk Corporation, later renamed SanDisk. It used flash memory, which was invented by Toshiba employee Fujio Masuoka in the early 1980s. Masuoka's invention could be quickly and easily read and written to many times.

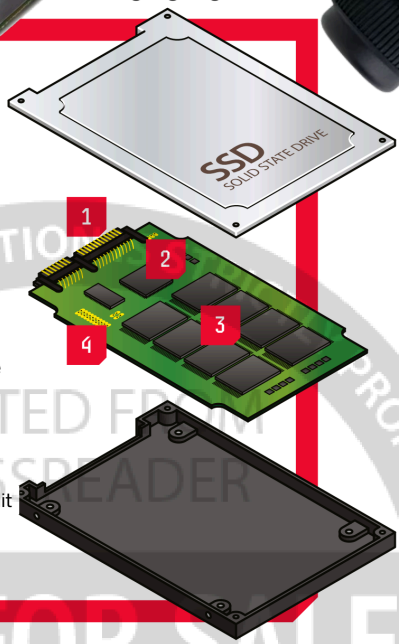
Masuoka came up with the concept after researching a more efficient successor to storage media that could retain data without a constant electric charge. Despite receiving industry-wide recognition for his invention, two decades would pass before flash memory became popular.

1 INTERFACE
An SSD connects to your computer via a SATA or PCIe interface on the motherboard.

2 CONTROLLER
This is the medium through which the PC communicates with the drive.

3 FLASH MEMORY
Data is stored on these chips. Writing data is more complicated and slower than reading it.

4 LOGIC BOARD
A piece of printed circuit board hosts the vital circuitry, memory and processing chips.



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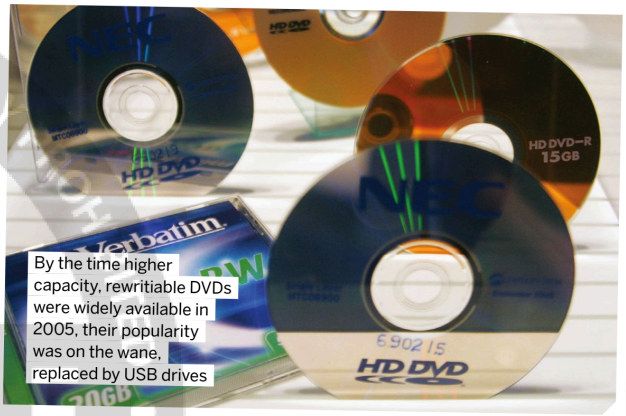
DID YOU KNOW? The biggest floppy disk held 512 gigabytes



Sony's first video game console, the PlayStation, was launched in 1994 with games stored on CD-ROM, helping to popularise this portable data storage medium

1992

SanDisk launched its high-capacity Compact flash memory units, which were rapidly adopted as the standard removable storage solution for digital camera manufacturers, among others.



By the time higher capacity, rewritiable DVDs were widely available in 2005, their popularity was on the wane, replaced by USB drives

1995

Two technology groups launched the digital versatile disc (DVD), which looked exactly like its predecessor, the compact disc, but with nearly ten times the capacity – 4.7 gigabytes versus 650 megabytes.

2000

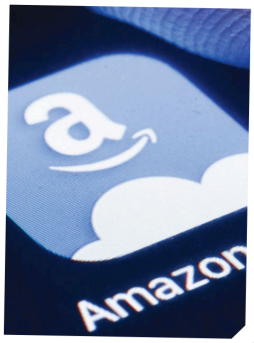
Flash memory went mainstream with USB flash drives, which combined high-capacity and fast flash memory with a USB interface in a pocket-sized enclosure.



USB flash drives suit a variety of purposes, like this high-capacity waterproof drive from Corsair

2006

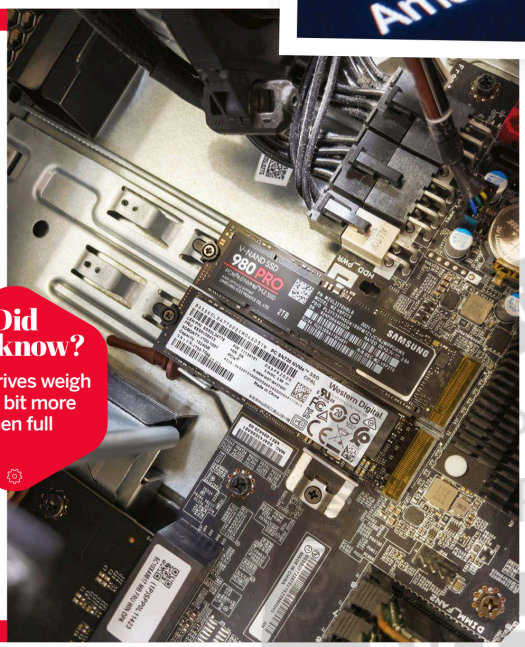
The rise of fast broadband internet access made cloud storage viable, with Amazon Web Services offering large file hosting that saved both consumers and businesses money and space.



2013

The Samsung XS1715 became the world's first NVMe drive – a drive format with lightning-fast read-write speeds based on IBM's solid state drive technology. It has become a standard for all modern PCs.

Did you know?
Hard drives weigh a tiny bit more when full



Modern NVMe drives have advantages over older solid state and hard disk technology, including saving physical space in PCs and laptops

PUNCHED CARD ORIGINS

In the French city of Lyon, 1725, Basile Bouchon came up with a novel method of speeding up textile production on the drawlooms of the day. These bulky mechanical machines required workers to manually lift the cords of the textile being woven by loom, which was an extremely time-consuming and tedious task. Bouchon's method involved rectangular cards, woven together in a loop, with holes punched into them. The cords were passed through needles that were raised according to whether a hole was present. His invention was improved upon over the years, though it wasn't until Jacquard made his machine in 1805 that it became popular.



Bouchon's loom was semi-automated, and still required a worker to feed cards into the machine

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