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HARDWARE

Data Storage: From Clay Tablets to SSDs

A USB flash drive is lying on the kitchen counter. Supposedly it contains thousands of recipes, photos of dishes, and music to cook by. Grandma eyes it suspiciously.

— Where do you keep all that?
— Right here.
— In that tiny bit of plastic?
— Yes.
— Then why have I spent forty years collecting six binders?
— Because you didn't have USB, Grandma.
— Well, my notebook works without electricity. Let's see what you say in thirty years.

And so begins our journey through the history of storage media: from clay and papyrus to flash memory and SSDs.

A recipe is not a jar

— We've got a new dumpling recipe! — shouts the cook.
— Write it down!
— On what? — asks the assistant.
— Anything, as long as somebody can read it later!

Data is the information itself: a recipe, a picture of a dish, a song, or an instructional video. A **storage medium** is the physical object that preserves it. A **reader or drive** is a device that retrieves it. A recipe is not a book, just as a file is not a floppy disk. The same content can move between different media.

And let's separate the roles. A chef following instructions resembles a processor; a worktop may help us picture RAM; cupboards and containers resemble persistent storage. Today we're not measuring how many dishes the chef can prepare per second. We're asking: **where do you keep a recipe so it survives when the lights go out?**

The world's oldest kitchen: clay, papyrus, and paper

Our first kitchen has no refrigerator, electricity, or even a drawer. Someone scratches information into clay and preserves the tablet.

— How heavy is the cookbook?
— Eight kilograms.
— Bring the cookbook to the pot, then.

— The pot hasn't been invented yet.
— Write down that somebody should invent one!

Clay tablets bearing cuneiform writing are known from Mesopotamia in the late fourth millennium BCE. They could preserve information for an astonishingly long time, but they were heavy and awkward to carry. Papyrus in ancient Egypt made lighter scrolls possible. Paper and books later made knowledge easier to copy, transport, and organize.

In kitchen terms, we travel from a heavy board with one recipe, through a scroll, to a notebook and a binder. Importantly, **paper is not digital, but it certainly is a storage medium**. It needs no special port or driver, although you still have to understand the language.

Punching holes in recipes: cards and paper tape

— Boss, the machine needs to cook soup from a recipe.
— Then let it read the recipe.
— It can't read our letters.
— Make some holes.
— In the soup?
— In the card, you genius!

A **punched card** stores information through a pattern of holes and solid areas. **Punched paper tape** uses a similar principle on a long strip. These media were used to control machines and enter data. Punched cards appeared in textile machinery in the early nineteenth century; Herman Hollerith's cards were used for the 1890 US Census.

There is no magic in the paper itself. The holes mean something only to a machine that understands their layout and coding. A stack of cards resembles a recipe binder readable by machinery. Drop the whole stack and mix up the order, and the kitchen manager may discover an entirely new vocabulary.

Magnetic tape: one very long roll of recipes

— I need the cheesecake recipe.
— It's at the end of the tape.
— And the soup recipe?
— At the beginning.
— So now I have to rewind the whole thing?
— Welcome to the archive, chef.

In computers, **magnetic tape** stores bits by magnetizing a coating. Its typical access is **sequential**: to reach a particular section, the tape must move. Magnetic tape became important in computing in the 1950s. Over time, huge reels gave way to compact cartridges and cassettes. Many home computers also loaded and saved programs on ordinary audio cassettes.

Tape isn't merely an inferior disk. It can be useful when storing large amounts of data in long runs. Professional archives still use it. In our kitchen, it's a very long pantry shelf: great for putting away entire deliveries, less handy when someone repeatedly asks for a single tiny spice jar.

Hard drives: the cupboard with spinning shelves

— Enough rewinding! — announces the manager.
— We need a cupboard that can get us straight to the recipe!
— What if it spins?
— Let it spin. As long as it finds oregano faster than Frank.

A **hard disk drive (HDD)** stores information magnetically on rigid, rotating platters. Read/write heads move to the relevant areas. This lets the system reach different locations without winding through an entire tape, although moving heads and platters still take time. The first commercial HDD, the IBM 350 in the RAMAC system, shipped in **1956**. It was enormous and stored only the equivalent of a few megabytes.

Don't confuse **access time** with **transfer speed**. Finding a spice jar and pouring out a whole sack of flour are two different tasks. HDDs remain useful when you need lots of capacity at a reasonable price. The detailed HDD-versus-SSD comparison belongs in its own article.

Floppy disks: recipes in an apron pocket

Eventually the chef wants to carry some recipes to another kitchen.

— I'm not taking the entire cupboard!
— Take a floppy disk.
— What size?
— Depends which decade you work in.

A **floppy disk** contains a flexible magnetic disk that spins inside a drive. The **8-inch** format entered commercial use in **1971**; **5.25-inch** disks appeared in **1976**; **3.5-inch** formats arrived in the early 1980s. There was also a distinct **3-inch** format used, among others, in Amstrad computers. A 3-inch disk was not just another name for a 3.5-inch disk: it needed a different drive.

Common PC 3.5-inch disks often held **1.44 MB**, but other sizes and capacities existed. Physical size, formatting, and drive compatibility all mattered. Not every disk fitted every drive, just as not every kitchen container works with every appliance.

— Why can't I put the big floppy into the small drive? — asks the assistant.
— Because it's a disk drive, not a potato masher.

CD, DVD, and Blu-ray: spices sealed at the factory

A delivery driver arrives with a shiny disc.

— I've brought a thousand recipes and a cooking program!
— Excellent. Pour them into our jar.
— You mean install the program on the hard drive?
— Yes, although installation can involve more than simply copying files. And don't throw away the original package!

Optical discs use a laser to read information encoded in a suitable recording layer. The **CD** became a consumer music format from 1982; **CD-ROM** followed for distributing data and software in the mid-1980s. **DVD** arrived in the second half of the 1990s, followed by consumer **Blu-ray** discs in the 2000s. Capacity increased while the reading and recording technologies evolved.

The suffix matters. **ROM** means a medium prepared for reading; **R** generally means recordable once; **RW** means rewritable. Other variations include DVD-RAM, BD-R, and BD-RE. A CD-R isn't a jar you can freely empty: already recorded areas normally cannot be erased. Additional sessions may be possible depending on how the disc was recorded.

— Why can't every drive read every disc?
— Because a screw-top jar and a tin can require different openers.

Compatibility has never been automatic.

Zip, Jaz, and magneto-optical: odd containers in the pantry

In the 1990s the kitchen acquires ever more types of containers. Some hold much more than floppies; others demand their own special readers.

— Boss, we have a Zip drive!
— And Jaz?
— That too.
— And the opener?
— The shop down the street doesn't sell it anymore.

Iomega Zip, introduced in **1994**, used removable disks starting at 100 MB. **Jaz**, introduced in the mid-1990s, used removable cartridges based on hard-drive-like technology; common versions held 1 or 2 GB. **Magneto-optical media** combine laser heating and magnetic recording, with optical methods used for reading. They were not all interchangeable formats.

These devices illustrate the **reader problem** perfectly. Your recipes may be intact, but if nobody has the matching drive, they're like tinned food without a can opener. The history of interfaces and formats matters almost as much as the physical survival of the contents.

Flash memory: resealable bags, cards, and SSDs

— Boss, the whole spice collection can now fit into a little box!
— Wonderful. How many spinning shelves does it have?
— None.
— THEN WHERE DOES THE WAREHOUSE CLERK WORK?!
— In the electronics, boss.

Flash memory preserves information in semiconductor cells that can keep their state without power. It needs no spinning platter or winding tape. The technology emerged in the 1980s. **USB flash drives**, **memory cards**, and most modern **SSDs** use flash memory. USB flash drives became widespread from about **2000**. CompactFlash cards appeared in 1994, while SD cards arrived around the turn of the millennium. Solid-state drives existed in different forms earlier, but later became mainstream computer storage.

A resealable bag might resemble a portable USB drive, a labelled little jar a memory card, and a sophisticated cupboard with no moving shelves an SSD. But remember: **USB, SD, SATA, and NVMe refer to different interfaces, connectors, or communication methods, not four separate physical principles of storing bits**.

Flash memory has finite write endurance and data-retention characteristics affected by design, wear, temperature, and storage conditions. No moving parts does not mean indestructible. And an SSD is not automatically a backup simply because it's fast.

Copying, moving, and reading: what happens to the recipe?

— I bought a program on CD! — says the chef.
— Install it.
— So I'm pouring the seasoning into our own jar?
— Sometimes, but the installer may also unpack files, create settings, and prepare the program to run.
— What if I make a copy?
— The original stays where it is, and new data appears on the second medium.

This is where the kitchen analogy reaches its limit. Pouring sugar moves material away from the source. **Digital copying** can create another copy without consuming the original. **Moving** a file may involve changing its location or copying and then deleting the source; the details depend on the system and media. **Reading** means retrieving a recipe, not necessarily changing it.

A tiny note can hang on the fridge, a thousand binders can fill a cupboard, and a memory card can sit in your pocket. Each solution has strengths and weaknesses. Capacity, cost, access time, throughput, rewrite capability, and reader availability all matter.

A timeline: several thousand years in one kitchen notebook

These dates are approximate milestones: invention, first practical use, and mass adoption did not necessarily happen in the same year. Multiple storage technologies coexisted for long periods.

- **About 3300–3000 BCE** — clay tablets and early writing in Mesopotamia.
- **Ancient Egypt, at least the third millennium BCE** — papyrus used as a writing material.
- **From the early centuries CE** — broader use of paper, developed earlier in China.
- **Early nineteenth century** — punched cards controlling textile machinery.
- **1890** — Hollerith's punched cards used in the US Census.
- **1950s** — magnetic computer tape; **1956** — IBM RAMAC commercial HDD.
- **1971** — 8-inch floppy; **1976** — 5.25-inch; **1981–1982** — early 3.5-inch disks.
- **1980s** — 3-inch floppies, home-computer tape cassettes, CD-ROM, and commercial magneto-optical media.
- **1982** — audio CDs; **1984–1985** — CD-ROM development; **1984** — flash memory invention.
- **1994** — Zip and CompactFlash; **1995** — Jaz; **late 1990s** — DVDs and popular recordable optical discs.
- **About 2000** — USB flash drives and SD cards; **2006** — consumer Blu-ray.
- **Twenty-first century** — rapid growth of SSDs, including NVMe-based models.

Grandma's final page

That evening the chef places the USB stick beside the old notebook.

— Grandma, this tiny thing holds more recipes than your whole cupboard.
— Can you read them all without a computer?
— No.

— And my dumpling recipe?
— Immediately.
— Then keep both your flash drive and my notebook. Just don't leave either beside a boiling pot.

From clay tablets to SSDs, the materials, recording methods, capacities, speeds, and portability have all changed. But the essential question is the same: **will the information survive, and will we still be able to read it?** The newest medium isn't always best for every job. And if those recipes really matter, read our article about **backups**. One jar, no matter how modern, is still just one jar.