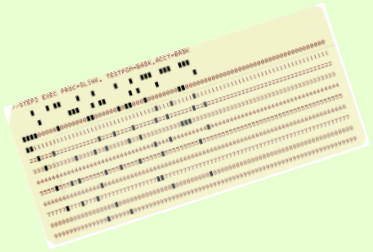
The myth of zeros and ones in computers

When people ask about the storage of **data** in computers, the immediate answer is that data is **stored as zeros and ones**. People then think that there are lots of zeros and ones, (0 and 1's) everywhere: in Pen Drives, in CD/DVDs, in Hard Disks, etc.

However, this not the case: there is not a single zero nor a single one in any place, in any computer. Data is not **stored as 0 and 1's** in any type on computer, no matter its size, no matter its architecture.



An 80-column punched card

The first practical technique of widespread use for storing data was with **punched cards**. In this system, **characters** were stored in columns with **holes or no holes**. There was **a code for each letter** of the alphabet, for many **special symbol**, like $, %, (,), etc.

No matter the code, no matter the media, at this time everything was cards and holes. The paradigm was: a **change** in information was coded by holes, **no change** in the card, **no information**.

This metaphor of pattern changes in the storage media is the one used today in the **Hard Disks of modern computers**. However, no holes are present, the technique is another: **magnetic fields**.

The interior of a Hard Disk

Pen Drives are virtually the same as cards or disks, except that they store data **electrostatically**; i.e., using tiny electric fields that keep their charges for long periods of time.

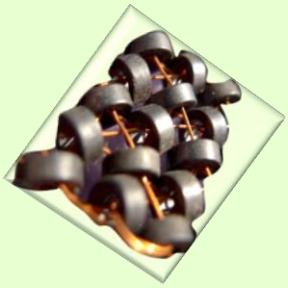
Hard Disks are coated with a thin layer of **ferromagnetic material** over a circular spinning plate. The concept is simple: **magnetic fields** are binary: that is; they are either north or south, up or down; (see more metaphors in here?).

Think of this coating as consisting of millions and millions of **small magnets** (in microscopic dust) that can be **individually manipulated** to change its magnetic direction. In this way we obtain the same results as the venerable old punched cards, but with denser data bits per square inch, faster transfer, weather protection, etc.

No matter the storage media we use, none of them uses zero and ones to hold information.

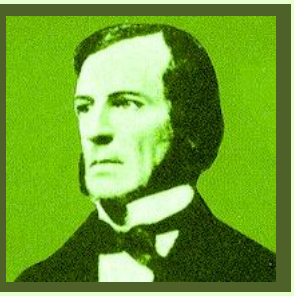
Hence, instead of thinking that your loved pictures are "**digitized**" as sequences of zeros and ones, like 10010011001010…, better think that they are "magnetized" strings of magnetic fields like NNSSNSSSNSNS… When documents are temporarily stored in the computer's memory ("electrified"?), or duplicated in a Pen drive (Flashy Drive), then those pictures, or music, are really stored as + + - + + - - + + - - + - + - …

Think of it, even numbers are not stored as numbers, but as binary states, no matter the technology of the media.



An early array of magnetic rings used to store data in magnetic fields.

George Boole (1815-1864). His book: *The Mathematical Analysis of Logic* opened an era that later greatly simplified the use of computers in logical reasoning.



Reference: Augarten, S. (1984). *Bit by Bit: An Illustrated History of Computers.* Ticknor & Fields. New York.