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Computer Data Fugit

by: Kenneth H. Nelson, P.E.

Ironically, this is the second version of this article I have written, and the events leading up to this rewrite substantiated the point I was trying to make in the first version. My intended theme was how preservation of digital data has evolved through the years, and how difficult it has been to achieve. I was working on this article on different computers and carrying it around on a USB (Universal Service Buss) drive until it was ready for final editing and printing. One morning when I was close to finishing, I plugged the USB drive into the computer, and a dire warning message appeared on the screen. I don't know how it happened, but the data was irretrievable, and there was nothing to do but start over. So to the best of my memory, and with reinforced conviction as to the conclusion, the reconstituted article is presented below. The title of the article was to be "Data Fugit", a reference to the Latin phrase "Tempus Fugit", which means "Time Flies". This ancient phrase was a reminder to take advantage of the present because time swiftly passes us by. As detailed in the article below, all means of electronic data storage pass with time, and it is a continuing struggle to preserve information in a readable form. In the end, we shall see that the oldest forms of recordation are sometimes the most durable.

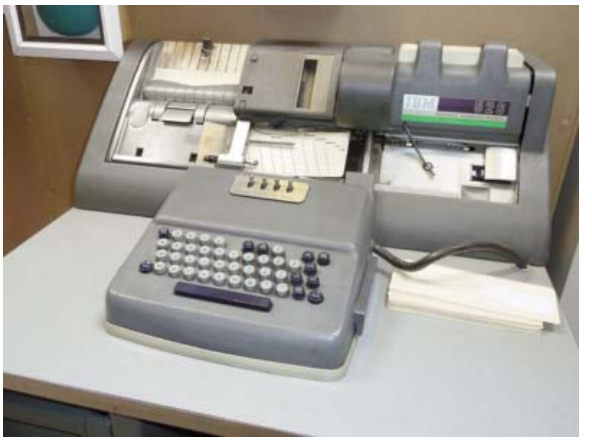
As a preface, here is some terminology of computer storage capacity that will appear throughout the article:

Kilobytes = thousands of pieces of information

Megabytes = millions of pieces of information

Gigabytes = billions of pieces of information

Terabytes = trillions of pieces of information



IBM Punch Card Machine
Photo - IBM Archives

While cleaning out an office recently, I came across the equivalent of an electronic archaeological dig. It contained virtually every form of portable data storage media that have been used since desktop computers came into widespread use. Before reviewing examples of the rapid development of technology that turned up in this office cleanup, for historical perspective let's go back to the beginning of computer usage in the engineering profession. Our company was an early adopter of electronic computing and began using mainframe computers in its practice in the 1950's. We were one of the first private firms in the area to have a mainframe, and even gave demonstrations of its capabilities to some government agencies who did not have them at the time. The programming of the early computers was done via paper cards with holes punched in them. These were a descendant of the cards used to define the patterns for large industrial looms. They had the advantage of not being subject to magnetic or electrical disturbance, but they were subject to moisture damage, and it was a catastrophe to drop the whole deck and have it fall out of order. The internal electronic memory capacity of these early machines seems laughable to current computer users, whose cellphones easily surpass the capacity of those giant machines. But we did some remarkable design work on them using ingenuity in writing our programs within the limited memory constraints, including the design of some of the earliest offshore platforms in the Gulf of Mexico. I remember the excitement when we purchased an add-on unit the size of a small

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refrigerator that increased the internal memory capacity of our mainframe from 16 kilobytes to 32 kilobytes. The computer had a removable magnetic disc about one foot in diameter with extra read / write storage capacity, but the calculating heart of the machine was originally doing its work with 16 kilobytes of memory! For comparison, a single photograph taken with a "smart phone" these days uses several megabytes of memory. Mainframe computers larger than the one we had used magnetic tape drives to store large volumes of data. They also used larger assemblies of magnetically coated discs like the single disc we had in our relatively small mainframe. In the 1970's I saw a large mainframe in a university that used a rotating ceramic cylinder about a foot in diameter and four feet long which was covered with a magnetic coating and spun at very high speed. A reading head traveled back and forth along the length of the cylinder, and the high rotational speed of the cylinder gave very fast access to a large area of storage space.

The hardware we use to do computer calculations and store the data has been ingeniously innovated through many generations in just a few decades, but equally important and fugitive are the software programs that handle the data. These programs are constantly being updated, and some go completely out of use. We were once asked to retrieve calculations for an offshore platform component that we had designed using a commercially available structural analysis program. Although only a bit over a decade past the design, we found that the magnetic tapes the data was stored on had been corrupted through physical deterioration, and the structural analysis program had become obsolete and was no longer supported by the publisher. Any user of a "smart phone" or desktop computer knows how frequently they get messages popping up to install the latest updates in programming, and the world of design and drafting programs is no different. Remarkable tools are available to aid the design process, but they are in a constant state of flux and their half-life seems to be ever shortening. It is a constant struggle to keep adjusting to the changing electronic landscape.

So, let's look at the many generations of storage media artifacts uncovered in the recent cleanup of just one office. The first form encountered was 5 ¼" "floppy discs" having storage capacity of 100 kilobytes for the earliest versions up to 1.2 megabytes for later versions.

These were thin plastic discs with a magnetic coating in a flexible plastic sleeve. The computer spun them at high speed to provide rapid access to any part of the surface where information was stored. They were useful for a short while until the size of files became so large that a single computer-generated drawing could not fit onto the disc. The next find was 3 ½" "hard discs", which were also thin plastic discs with a magnetic coating, but were in a hard plastic protective sleeve and had capacities from 720 kilobytes up to 2.88 megabytes. In addition to the increased capacity, they had the physical robustness to allow them to be tossed in a briefcase and carried around with some confidence that they would not be damaged. As programs became more intensive users of memory, the industry developed "zip drives", which looked similar to the hard discs but were thicker and had what at the time seemed an astounding capacity of 100 megabytes up to 750 megabytes. Several of these were found in the office, but the reign of the zip drive was also short lived. All of these magnetic storage media could be erased either intentionally or inadvertently, so in addition to the obsolescence of the hardware that read them, the data was always at risk of being erased. Even if one kept the old hardware and software running to read them, the plastic itself was eventually subject to physical deterioration within a relatively short span of years. All three forms of the above described magnetically coated spinning plastic discs which were uncovered in our digging through the office had a prime useful life of only a decade or even less.

The next storage media encountered in our archaeological dig were compact discs, or "CD's", which were hard clear plastic discs that could be etched by a laser in the computer to make permanent records and typically had a capacity of about 650 megabytes. They could only be etched once, so their main use was for archival purposes.

Eventually digital video discs, or "DVD's" were adapted for data storage use and brought the capacity of a single disc up to about 4.7 gigabytes. These were also one-time use etchable media and mainly useful for archival purposes. Computer manufacturers saw a need and market for the ability to use the CD's and DVD's in a manner similar to the old magnetic media, so they developed readable-writable discs, or "CD-RW" and "DVD-RW", which could be used multiple times

and allowed editing of files. Ultimately however, these remained at risk of physical deterioration and obsolescence of the hardware and software needed to read them.

The next form of portable storage media encountered were solid state electronic devices that plugged into a universal service buss port, or USB port on the computer. These were variously described as "thumb drives", "jump drives", or "flash drives". The first one of these I bought was on sale because it was rapidly becoming obsolete at its modest capacity of 128 megabytes. I still have it many years later, and this article briefly resided on it before being transferred to other media. These USB devices rapidly evolved to have gigabytes of memory capacity, and the price declined to the point that vendors handed them out as promotional trinkets at trade shows. In fact, one of those trinkets was the drive that failed and led to the rewrite of this article. The failure could have been due to "operator error" or just mass manufacturing bad luck, but it meant the loss of hours of writing, and could have been more consequential if it had been storing commercially valuable information. The last form of portable storage encountered were external hard drives. These devices plugged into a USB port and rapidly developed from megabytes to gigabytes to terabytes of capacity. There seemed to be a constant race to sell them off before the next generation came onto the market with more capacity at a lower price.

As the forms of storage media developed at breakneck speed, the cost came down in equally fast increments. File storage servers with many terabytes of memory became commonplace, and ultimately subscription storage services developed that will store your data in large offsite facilities and let you access it over the internet. This type of service is called "cloud storage" and has the advantage of being professionally maintained with robust backup systems, although I have heard one user lament that something went wrong with theirs and the "cloud" became the "fog" for some period of time. There was also a famous case in which a major corporation lost all its data due a cloud failure, so nothing is foolproof.

It is ironic, but the most stable form of data storage we have seen are the humble markings of graphite pencil or drafting ink on a sheet of good quality paper that has been kept in a dry place. Calculations and drawings stored like this can be read many decades or centuries later, as shown by the famous design notebooks made by Leonardo da Vinci during the Renaissance. and reading these can be done without the need for electric power, which is required for any tpe of computer memory! For a time in the latter part of the 20th century, engineering drawings were put on sheets of mylar plastic instead of vellum paper because mylar was waterproof and considered more dimensionally stable than paper. However, within relatively few years the surface of the mylar could start breaking down and flake off, and I have seen with dismay the original becoming useless as it rolled out of the reproduction machine one last time with the image flaking off.

In the late 1940's, a cache of scrolls written on parchment paper was discovered in the Middle East. They became known as the Dead Sea Scrolls, and have been estimated to date from about two thousand years ago. Clay tablets inscribed with early forms of writing have survived from millennia ago, and the hieroglyphics carved in the Egyptian pyramids date to approximately four or five thousand years ago. Humankind has attempted to pass down its history by many means throughout time. The important lesson to take away is that regardless of the means of recordation, the window of time to teach about the transfer of information is only one generation. We must constantly work to instruct the generation coming behind us the importance of preserving our hard won body of knowledge, its fragility, and along with it the fragility of civilization.

UNO 2018 Crawfish Mambo

Winning Best Decorated Booth was team "Welcome To The Jungle". Team members were Martin Patterson (Captain), Luan Van Tran, Casey & Leanne Geohegan, Rachel Delatte, Aimee Hill, Justin Bertheaud and Nathan Linhardt. Ken Nelson, center, stopped by to congratulate the teams.

Team "Nelson's Hippies" boiled over 1000 lbs of crawfish! Team members were Garry & Angela Fehn (Captain). Michelle Jones (Co-Captain), Tonya Coleman, Anthony Beard, Wil Stone, Brent Fehn and Nicole Buckeridge.

18th Annual Society of Petroleum Engineers Sporting Clays Tournament

The Sporting Clays Tournament is a large provider to the SPE-GCS Scholarship Fund. Participants from the Houston office were, l to r: Robert Griffin, client Jack Lammlein, Marcel Danos, and clients Jason Zamaitis and Michael Dubravec.

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Congratulations to Roy Phelps

Roy Phelps was elected to the statewide Board of Directors for the Louisiana Engineering Society for the 2018-2019 term. Roy served as president of the New Orleans branch of LES for the 2016-2017 term.

NELSON placed #317 on the ENR Top 500 Design Firms list for 2018, based on 2017 fiscal year revenue.