Computer History Museum

Volunteer Information Exchange

Sharing what we know with those we know

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Contribute To The VIE

The necessity for punched cards existed long after the dawn of the computer age. In the early 60s, cards were still the primary input medium for computers and of course programs were all written on cards. Jeff Katz tells us about his experiences in trying to ensure that the punched card input and output devices on Univac computers were tested properly. Thanks to Jeff for his insights and memories of that era.

We are rightfully proud of our 1401 restoration team and what they have accomplished. But there is another team, back East, with a similar goal, restoring an IBM 1440. We bring you up-to-date.

Thanks once again to Chris Garcia for his article on Recent Acquisitions. I always see things I never knew existed.

We are always looking for your stories and anecdotes, facts and factoids and if you find something on the net that relates to us, please send us the link so we can pass it on to others.

Jim Strickland
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CHM Blog

Recent CHM Blog Entries

Kirsten Tashev keeps us up-to-date on new CHM blog entries.

- Guest blogger Jonathan Rotenberg, founder of the Boston Computer Society (BCS) writes on the Computer History Museum's release of 21 historic, newly digitized films from its media archives featuring the BCS historic lecture series. This blog post is the first in a series that will be posted over the course of the year. http://www.computerhistory.org/atchm/the-boston-computer-society-presents-1981-forum-on-the-future-of-personal-computers/

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IBM 056: Visitor Story

JIM STRICKLAND

A visitor recently told me a story … It seems that, in the late 60's, he was in the army in Vietnam, serving as a programmer on a 1460, the bigger, faster version of the 1401.

His unit had two shifts of key punchers; in the daytime Vietnamese women and at night, US enlisted men. The job was such that the night-shift men could go home when they were done.

Both teams key punched and then verified their input using IBM 056 verifiers. The verification process required the 056 operators to re-key the data from the same documents that the key puncher used. If the keying was the same, the verifier put a little notch in the trailing edge of the card. (For more on the verification process.)

Well, someone on the night shift figured out that they could program the 056 to take a stack of blank cards and "verify the blanks," resulting in a notch the blank card. Then they would do their key punching on "pre-verified" cards. With no real verifying needed, they could all go home.

It worked for some time, but one night my visitor left a program to be be punched (and verified).

It was punched on the "pre-verified" cards but that did not fool the compiler. It found many errors that the programmer had not created. He realized that the cards could not have been verified.

He took it to the captain and they investigated. In a cabinet they found boxes of the notched, "pre-verified" cards.

The game was up. The night shift was punished and never got an early exit again.

Tales of the Univac Punched Card Era

JEFF KATZ

Many of us who have gray (or missing) hair can recall the frustrations of writing and debugging programs by key-punching large decks of individual instruction cards, usually in the middle of the night, in order to get key-punch time when the paid operators were off duty. Then submitting the decks, hopefully in the intended card order, to the batch processing window at the off-limits computer center, and waiting up to a day for the card deck to be returned with a printout of our intended results or else a notice that the program failed to complete accompanied by a "core dump" printout of the machine state at the time of the failure that could be used to try to ascertain the problem and fix the program. Then start the cycle again, and again until the program finally worked.

Well this note is not a re-hash of those woes. Instead it's a brief look at some underlying technology behind the punched card equipment that was attached to the mainframes (and 1401s) to read and produce decks of card data and perform input and output with that medium, much more efficiently than individuals could do it with keyboards. And there's a test philosophy fallacy to expose, too.

My first job out of university in the mid-1960s with my fresh degree in Computer Engineering was with Univac's 1100 series mainframe development team. But before being allowed to design any computers, I was required to train for a year on the equipment test floor along with the seasoned test techs and a small crop of new-hire engineers like myself. I was assigned to a group that did the testing of Univac's punched card equipment. One of the main customers for fully-loaded 1108 systems was NASA, in support of the Apollo space program. Their programs were large, meaning that their card decks were very large.

One of the Univac attractions to NASA and other scientific customers was their very fast card reader and punch subsystem, which at the time was the industry's performance leader. The 5010 series readers processed cards at 900 cards per minute, reading and transporting cards at 15 per second using photodiodes, not electric/mechanical brushes, to sense the presence or absence of card holes. The readers processed the cards column-wise, through a sensing block of 12 photodiodes (one for each row on the card) that each had its own light source mounted above. It was actually very reliable as well as much faster compared to traditional brush-sensing readers.

Perhaps even more impressive, the 5010 series high-speed card punch machines could output cards continuously at 300 cards per minute, gang-punching row-wise up to 80 holes per row and 12 rows per card at the rate of 5 complete cards, or 60 punch actions, per second, for each column. To actually poke a clean rectangular hole through a card of course required mechanical technology, not photoelectric or bulky laser technology. There was a complex mechanism of 80 tightly packed punch-and-die sets along with individual relay-driven actuators to drive each punch. (Think of the complexity of the Babbage Engine figure wheels but packed in on 2 mm centers.) And there was an equally complex transport mechanism that had to pick and move the card stock past the dies at the precise speed to correctly position each row under the dies at the proper time for the actuators to drive the required punches.

The test floor was part of the Quality Assurance department. Engineers in that department worked with the equipment design engineers to create appropriate testing routines that assured all capabilities of the equipment met advertised specifications before releasing the equipment for shipment to a customer. Like many QA departments that one followed a practice of adjusting the acceptance specs based on the experience of testing. Also it was generally known that most computer equipment failures manifest themselves in the early life of the equipment. For example if a device category consistently exhibited no failures during a 2 or 3 hour acceptance test over many samples of the device being tested, the test time might be reduced to only 1 hour with pretty high confidence that few if any bad samples would get through the acceptance test. On the other hand, if there was a significant error rate in the 2 or 3 hour tests for a given device, then the test time might be increased to 4 or 5 hours to be sure to weed out any failures before accepting the equipment for shipment. That's all pretty standard QA practice for electronic equipment.

But not so much for mechanical equipment. In their zeal to overstress the equipment with tests that exceeded what the customer was likely to do with it, thus ensuring the equipment would breeze through final acceptance at the customer site, the test engineers devised test floor acceptance tests that worked the punched card equipment unrealistically way too hard. For example they required the card reader to work continuously, recirculating the cards from the output tray directly back to the input hopper for 1-2 hours with no stop to cool down or reload a new deck. (It was a tedious job to tend that test!) Even worse the card punch was required to punch patterns that would never occur in normal computer programs or data files, such as checkerboard or every hole on the card. And this for several hours non-stop.

The net results were that card decks literally wore out by being continuously recirculated through the reader at 15 per second, to the point that their leading and trailing edges began to fray causing jams at the picker knife or the sensor throat. And in the punch, transport pinch-rollers could wear or glaze, changing the transport speed and thus altering the precise timing of when each card row is ready to be punched. Naturally such failures would happen about 80% through an otherwise successful acceptance run, then requiring a complete re-run. And

with multiple acceptance attempts, the unrealistic punch patterns could literally wear out the punch-and die or vibrate badly enough to shake the transport mechanisms loose and out of adjustment. Then of course with demonstrated early-life test failures, the protocol required that the test times be increased. Which of course only exacerbated the problems, making it a rare equipment set that made it easily through test floor acceptance and got shipped to the customer with minimal wear and tear.

The Upshot: More than once during that year I spent on Univac's test floor, I was sent to one NASA site or another to update and repair punched card equipment that had fairly recently been delivered, but was already exhibiting late-life failures because much of its life had been used up during factory testing.

IBM 1440 Restoration Project Update

JIM STRICKLAND

In 2013, I visited the old IBM facility in Endicott, New York, which is now almost entirely empty, and a small museum to which IBM had donated their collection of IBM Endicott artifacts. On that trip I also visited a 1440 restoration project in Binghampton, New York.

The 1440 was the low cost little brother of the 1401, announced in October of 1962. It introduced the 1311 small, removable disk drive and a rudimentary operating system. Much of the 1440 was designed in San Jose and most of the 3,000 or so that were manufactured came from IBM's Cottle Road facility.

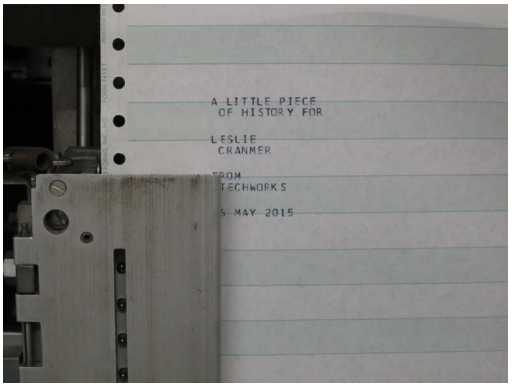


I had not heard from the restoration team for a while and their web site seemed to be unchanged, so I wrote to them. Here is an update on the project from Bill Green.

- The 1440 photo on the web site now shows the system components just sitting there shortly after they were moved up to the raised floor in 2014. We tried to mimic a publicity photo we found in our 1440 manual. Things have advanced from what you see in that photo. [The photo at the right is current.]
- During 2014, we built the raised floor and moved all the equipment onto the raised floor. We had the local electricians install 3 phase disconnects for both the 1440 and for the 1403 projects.
- With the raised floor mostly done, we connected the 1440 system components together and got back to debugging the 1442/1441interface [the 1442 is a low cost reader; 1441 is the CPU.]
- We have gotten past a few cold solder joints and made some resistor value changes in the 1442/1441 interface board. Data from a card has been read into the 1441 but there are some areas needing attention in both the interface board and 1441.
- The printer support group worked on getting it back into running order. [The 1440 used a slow, low cost printer called the 1443. The restoration group is rebuilding a 1403 – N1, the very fast,1100 line per minute big brother of our 1403's.]



- Also, the printer group is:
  - Doing general clean up
  - Getting a missing print train idler gear made
  - Replacing one broken tractor belt
  - Designing modern electronics to control the printing
  - Starting to build the control electronics.
  - At this time the printer can print 32 of its 132 columns. There are more circuit boards to assemble and more cabling to build/install. Holders for the new cards were made on a 3D printer.
- We'll get there.



We are sure you will, Bill and we wish you a speedy journey.

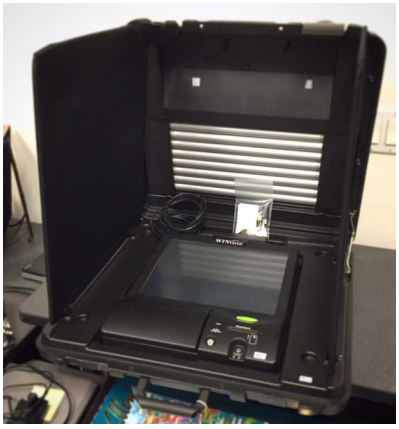
Recent Acquisitions

Chris Garcia

Personal Peripherals SuperSketch, US, 1984

SuperSketch system was designed to give kids a way to draw using their computer. Using a cartridge and a tethered 'command module' drawing pad, it allowed for easy copying and tracing of drawings. The user would place the drawing on the tablet, then trace the drawing using the attached arm, which would then be entered into the computer. The user could then manipulate the image using software, with operations such as fill allowing the drawings to be colored. SuperSketch was available for systems like the Commodore 64/128, Atari 400/800, and the TI 99/4A.

Gift of Tristan Fillmore, X7590.2016



Advanced Voting Solutions WinVote Voting Machine, US, 2002

Electronic voting machines date back to the 1960s, when punched card accounting equipment came into use. The 'hanging chad' controversy of the 2000 election between George W. Bush and Al Gore led to a cry for computerized voting solutions. The WinVote system is a Direct Recording Electronic system, that is a voting device that records voters choices electronically, and also prints a copy of the voter's ballot choices. It uses a version of Windows NT for embedded systems, fifteen 15-inch color screen, and an integral printer. Voters can zoom in to enlarge text, and are allowed to review their final votes before the printout is created and their vote finalized. The WinVote system has been heavily criticized for not being secure enough, largely due to its use of unencrypted wireless technologies as well as the physical insecurity of its external ports and memory cards.

Gift of Jeremy Epstein, X7593.2016



Hitachi Xybernaut Poma Wearable PC, Japan, 2002

Wearable computers are the product of advances in miniaturization, increased storage capacity, and input-output technologies. Xybernaut had already developed systems for use in niche applications such as aerospace, and teamed with Hitachi to develop the consumer-oriented Poma. The Poma used a 128MHz RISC processor with 32 MB of RAM, and ran the Windows CE operating system. It offered a high-definition, head-mounted display that gave the illusion of looking at a 13-inch screen. For input, it used a miniature keyboard that strapped to the user's forearm and an optical mouse. The system was bulky, the hardware slow, and it cost $1,500--more than many full-featured PCs at the time. Despite that, it found use in retail and hospitality, as well as by the US Army. The Poma did not sell well to the general public and Xybernaut was forced into bankruptcy in 2005.

Gift of Paul Rahilly, X7591.2016



Apple Macintosh with Avid Media Composer System, US, ca. 1992

Before the 1990s, the world of film editing had not changed much in the hundred years since its invention. Editors still used variations on light tables, razor blades, and tape to assemble their films serially. The introduction of non-linear editing allowed editors to work with video in chunks, allowing them to re-organize and test edits without costly film duplication and re-cutting. This greatly sped up the editing process and over time would eliminate many of the traditional tools of the film editor. AVID introduced their first system in 1988, but it wasn't until the 1992 film *Let's Kill All The Lawyers* that a feature film was edited using AVID. This system, integrated into a Power Macintosh 9600, includes Film Composer, an editing system used to edit films including *Emerson Park* (1994) and *The English Patient* (1996) - the first film edited with non-linear editing software to win an Oscar. Today, nearly all Hollywood films are cut using systems like AVID.

Gift of Hugh Kinniburgh, X7597.2016

Printing Checks and Bills on Cards

JIM STRICKLAND



In the the “Social Security” display in the Punched Card Gallery there is picture of Ida May Fuller, the first person to receive a monthly Social Security check. And the check is a punched card. Ever wonder how they printed the name and amount on that card? And of course over time utility bills were printed on cards. How did they do that?

I don't know positively but I'm pretty sure that the Social Security Board (now known as the Social Security Administration) pioneered the use of “bill feed” devices on tabulators. As a matter of fact, I'll bet they defined the requirement and IBM had to answer to meet the Social Security commitments. (We know that the collator was based on a Social Security Board requirement that IBM had to answer.)

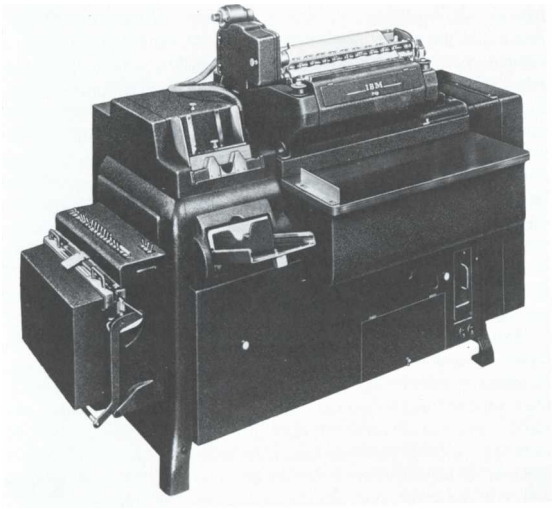
So what is a “bill feed?”

To step back a little. In 1928, IBM changed from the 40 column round hole card to the 80 column rectangular hole card and in 1931 introduced an alphabetic capability including the IBM 401 tabulator. The 405 was introduced in 1934 and became the industry workhorse.

In 1935, we passed the Social Security act and IBM won the business. The task of social security record keeping was a huge operation–one that many skeptics said was impossible. Indeed, a French industrial expert hired to advise the government, concluded simply: "It can't be done. The government should just abandon the whole idea." Preliminary estimates were that 26 million individual social security accounts would have to be set up before the end of 1937–the first year of the program's operation. Actually, over 33 million accounts were established during that period. That year, the system was operational and the first check was written to Ernest Ackerman who had worked one day under Social Security—Jan. 1, 1937. His wages for that day were $5. He paid his payroll tax of one nickel and he received a one-time check from Social Security for 17 cents.

Now, back to the bill feed.

Tabulators before and after the 405 used almost exclusively continuous forms. Some had control punching along the edges. Control punched forms debuted on the retail counter top in devices for handwriting customer receipts in 1917. They were adapted to tabulators in the 30's, I think. Control punches were especially useful for keeping multi-part forms in alignment. Continuous forms without control punching used the pressure of rollers against a round platen to advance the forms.



IBM 405 Tabulator
(Shown with platen feed device)

I *surmise* that the Social Security Board saw the efficiency of issuing punched card checks so that check reconciliation could be automated. This meant that they needed to be able to print name and amount on a card pre-punched with a number. Pre-punched numbers allowed both later reconciliation and security—no missing checks. To accomplish that, the bill feed was invented—a device to feed cards, one at a time, to the 405 which would print on the cards.

By the time I came to know a little bit about IBM equipment, the tabulator of choice was the IBM 403 introduced in 1948 which could be ordered with a special device, the IBM Type 916 bill feed. When, in 1957, the IBM 407 tabulator was introduced, a companion, the IBM 408 was announced also. It was a 407 with an integrated bill feed device.



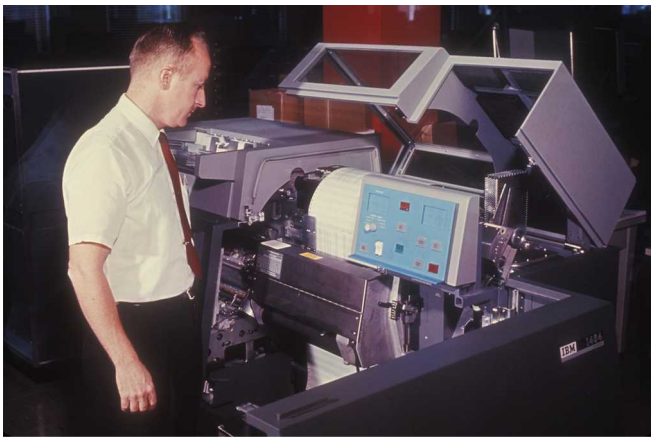
IBM 408 with bill feed in place

Pictured is an IBM 408 with its bill feed capability. The bill feed fed single cards from left to right. It also had a read station and very limited wiring panel, so that it could read the pre-punched number and make sure that right card was printed with the right information. The bill feed "tipped up" to the left so that it could moved out of the way for continuous forms printing.

When computers came along, the need was still there and IBM responded with a special version of the 1403 called the 1404.

From the IBM announcement, June, 1961

> The 1404 can print on continuous forms at a rated speed of 600 lines per minute; or it can print on card documents at a maximum rate of 800 cards per minute. Simply by positioning a movable print unit before the card feeding mechanism and pushing a switch, an operator can change from continuous forms feeding to card document feeding. Conveniently located controls, hoppers, and stackers, all accessible from the front, permit easy operation.
>
> The 1404 can process cards of many sizes, ranging from a single 51-column card to an 80-column card with an 80-column stub. It can also process two cards (either 51- or 80-column) at one time. As many as 25 lines of data, either from 1401 core storage, or from the card itself, can be printed on a card.



So that's how they did it. Or, at least that's how most customers with a requirement for high volume printing of punched card checks or bills did it. There was another solution, continuous form cards. But that is a story for another day.

What Do You Call the @?

It all depends on where you live … A Dutchman calls it a monkey's tail, while an Israeli insists it's a strudel. They aren't bantering about some new simian-themed bakery; they're just describing the @. Though shorthand use of the @ dates back to the 16th century, it took English speakers a remarkably long time to settle on a name.

Today, we know It as the "at mark" "at sign" or "commercial at" and are most used to seeing it in e-mail addresses.

Meanwhile, the rest of the world was inventing brilliant descriptors, like the "little dog" (Russian), the "small snail" (Italian), and the straight-up "crazy A" (Bosnian).

I like the Bosnian idea. What's your vote?

Coming Events (Click for details)			
Date	**Day**	**Time**	**Event**
Sept 24	Thurs.	6:00Members only reception 7:00 Program 9:00Adjourn	MIT's Cynthia Breazeal and Microsoft Research's Eric Horvitz with the BBC's Rory Cellan-Jones
Sept 26	Sat.	9:30 Check-in 10:00 – 4:00 Program	Design_Code_Build Educator Edition
Sept 27 Oct 17 Nov. 14	Sun. Sat. Sat.	9:30 AM Check in 10:00 – 4:00 Program	Design_Code_Build from Broadcom
Oct. 21	Wed.	6:00 Registration Opens 7:00 PM Program Starts 8:30 PM Book Signing	"How We Got To Now" Author Steven Johnson with the Museum's CEO John Hollar
Jan. 14	Thur.	7:00 PM 8:30 End	An Evening with the U.S. Digital Service Team Speakers from the U.S. Digital Services Team which is part of the Office of Management and Budget, in conversation with John Hollar.