Computer History Museum

Volunteer Information Exchange

Sharing what we know with those we know
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Contribute To The VIE

This VIE highlights the Illiac IV, a groundbreaking early parallel computer. Harry Sello and Kim Harris have contributed stories about it.

Do you have a favorite artifact, one that you know a great deal about? One that you know a great story about?

Help us ensure that all those stories are passed along. Contribute to the VIE.

Jim Strickland jlstrick@aol.com

The computer is mightier than the pen, the sword and usually, the programmer.

Questions

These questions need your answers

Q: The Hollerith sorter has 26 slots. 24 of those are under control of the tabulator. Two have manual handles, and are not controlled by the tabulator. Tim Robinson asks, "Does anyone know what those two manually operated slots would have been for?"

Q: I know that when Xerox PARC gave extensive demos of the Alto computer, windows user interface, etc. to Xerox executives in Rochester, NY, the execs were not impressed, but (some of) their wives were. My question is: I heard that one of those wives later started a high tech company. Who, what company, was it successful, and did they use anything from PARC? *Kim Harris*

Docent Opportunity and Special Exhibition

By Jim McClure

In mid-October, CHM is opening a small new exhibit, *An Analog Life: Remembering Jim Williams*.

Williams was a remarkable, self-taught engineer, artist, teacher, and mentor who set the bar high for the entire analog-engineering community. The new exhibit will feature Williams' famous analog workbench from Linear Technology.

We anticipate that a docent will work with the public at the new exhibit once a day – probably around 3:30 PM.

If you wish to work with the exhibit, there will be a required training session on Wednesday, October 12, 2011, from 10:00 AM until noon.

Contact Jim McClure if you want to attend that training. A second training session may be scheduled at a later time.

The exhibit opens on Saturday, October 15, 2011.

There will be a special exhibit-opening event in the *CHM Presents* Speaker Series in the evening of the 15th.

For information about the evening event, go to:

http://www.computerhistory.org/events/#an-analog-life-remembering-jim

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IN MEMORIAM

Tony Sale passed away on August 29.

Tony Sale was a brilliant engineer who led the rebuild of Colossus, said by some to be the first modern computer. Most recently, Mr. Sale drove the campaign to save Bletchley Park, where Colossus aided Allied code-cracking efforts during World War II.

Born in 1931, Mr Sale displayed his talent for engineering at an early age by building a robot, called George I, out of Meccano. One of the later versions of George was built from the remains of a Wellington bomber.

Instead of going to university, Mr Sale joined the RAF, which nurtured his engineering talent, and by the age of 20 he was lecturing pilots and air crew about advances in radar. His career included a six-year stint as a scientific officer at MI5. He rose to become principal scientific officer of the intelligence agency. On leaving MI5 he established, ran and sold a variety of software and engineering firms.

The mammoth project to recreate the code-cracking Colossus capped a career built around electronics and computers. At Bletchley he also founded the National Museum of Computing to help preserve the UK's aging computers. The rebuilt Colossus became the centrepiece of The National Museum of Computing (TNMOC) that Mr Sale established at Bletchley Park.

"Tony's contributions to The National Museum of Computing have been immense and I am quite sure that without his remarkable talents, enthusiasm, and drive, the museum would not have come into existence," said Andy Clark, chairman of the TNMOC trustees.

IN MEMORIAM

Julius Blank was one of the 'Traitorous Eight' who left the Shockley Semiconductor Laboratory division of Beckman Instruments, to start Fairchild Semiconductor and give rise to Silicon Valley. He died Saturday, September 17 of natural causes at 86.

Blank was born and raised in New York. He earned a Bachelor's degree in mechanical engineering from the City College of New York and recently lived in Palo Alto.

Blank never liked the term "traitorous", explaining in a May interview that he and Robert Noyce, Gordon Moore, Eugene Kleiner, Jean Honeri, Victor Grinich, Jay Last and Sheldon Roberts never betrayed Shockley. But, once it got into print," Blank said of the name, "it's hard to erase."

Blank said difficulties had accelerated when Shockley won the Nobel Prize: "He would travel a lot and every time he came back, he would change direction," Blank said. In light of these changing whims, their projects never were completed and many at Shockley grew frustrated." Blank spoke of "those years with 'a kind of electricity in the air, [where] everything was happening fast and all at once.'

Whatever the motivation, there is no denying that Blank and the other seven changed history from their cramped Palo Alto headquarters. It was at Fairchild that the brilliant engineers developed a viable process to mass produce the semiconductors that have become ubiquitous in everyday life.

At the time Fairchild launched, Blank recalled earlier this year, there was no road map to where the company wanted to go. First there was the struggle for financial backing, which eventually came from pioneer venture capitalist Arthur Rock.

Then there was building an industry from scratch. "We had to create markets that didn't exist," he said. "We had to build equipment that didn't exist also." It was Blank's job to build that equipment and oversee the rest of the operations at the fledgling company.

"He put a machine shop in place, hired the people we needed. He sure was a good engineer," Intel co-founder Gordon Moore recalled Monday.

ILLIAC IV: Groundbreaker

Illiac IV was one of the most infamous supercomputers ever. The ILLIACs were a series of computers built at a variety of locations, some at the University of Illinois at Champaign-Urbana. In all, five computers were built in this series between 1951 and 1974. ILLIAC's I, II, and III were groundbreaking and very successful projects. ILLIAC III (1966) was an early parallel computer.

In 1964, the same year that the CDC 6600 was announced, the University signed a contract with DARPA (Defense Advanced Research Projects Agency) to fund an effort, which came to be known as ILLIAC IV, to build a massively parallel computer. Key to the design was parallel operation with 256 processors allowing it to work on large data sets in what would later be known as vector processing. Design called for a processing rate of 1 gigaflop.

Later a design modification was made to divide the processors into quadrants of 64, housed in separate cabinets. Eventually it became clear that only one quadrant could be built in a realistic time frame, reducing performance from 1 gigaflop to about 200 megaflops.

ILLIAC IV was designed by Burroughs Corporation and built in Great Valley, PA from 1967 to 1972, with the first (and only) quadrant delivered to the University of Illinois in the summer of 1972. It had a Burroughs B6500 to act as a front-end controller. Burroughs also supplied the specialized disk drive, which featured a separate stationary head for every track and gave speeds up to 500 Mbit/s and stored about 80 MB per 36" disk. Each processor had 2048, 64 bit, words of thin film memory which was later replaced with semi-conductor memory from Fairchild.

The late 60's were a time of turmoil in the US. Viet Nam war protests disrupted many university campuses. So, when the computer was being built it was met with hostility by protesters who were suspicious of the University's tie with the Department of Defense and felt that the University had sold out. The protests reached a boiling point on May 9, 1970, in a day of "Illiaction". Three months after the bombing at a University of Wisconsin mathematics building, the University of Illinois decided to back out of the project, and have it moved to a more secure location.

The project was picked up by NASA, which formed a new advanced computing division, and moved the machine to Ames Research Center at Moffett Field.

The move slowed development, and new owner, NASA, made design changes which slowed it further. For example NASA decided to replace the B6500 with a PDP-10 but this required the development of new compilers and support software. So, the machine was not completed until 1972.

When the ILLIAC was finally turned on in 1972, it was found to be barely operable, failing continually. Improvements in reliability allowed it to run its first complete program in 1974, and go into full operation in 1975. Even "full operation" was somewhat limited; the machine was operated only Monday to Friday and had up to 40 hours of planned maintenance a week. The first full application was run on the machine in 1976, the same year the Cray-1 was released with roughly the same performance. It was shut down in August of 1981.

In addition to being massively parallel, it was massively late, massively over budget, and massively outperformed by existing commercial machines such as Cray-1 but ground had been broken and the future of supercomputing had been established – it would be massively parallel.

By Kim Harris

One Monday morning, the staff of the project (called the IAC, Institute for Advanced Computation, after von Neuman's IAS, Institute for Advanced Study) was told that over the weekend, the Illiac IV had done more multiplications than had ever been done in the history of the earth. That brings to memory that the ENIAC performed more multiplications than had ever been done in the history of the earth, although over its lifetime. When the Illiac IV was good, it was very good; when it was down, it was down for weeks and sometimes months.

I was the Manager of Technical Operations at one time, and had to manage how we handled outages. We had technicians on premises 24/7. My directive was: when it first went down, the technicians would start to work on it. If it wasn't running in 2 hours, an engineer was called in. We had two engineers who were the experts, and they were called a lot in the middle of the night. If it wasn't working in 4 hours, I was to be called. Then I'd ask what was being done, and if everything we could do was happening, I'd say "keep up the good work" and I'd go back to sleep. There were times when I got called every night around 4 AM for weeks at a time.

Ditto what I said before about "when it was good ..."

ILLIAC IV in development:

Foreground - Three Burroughs 36 inch, 80 megabyte disc drives;

Background - processing circuitry;

Left – memory unit.

ILLIAC IV Software

Illiac IV hardware design was largely the responsibility of Burroughs, while work at the University of Illinois was primarily aimed at ways to efficiently fill the processors with data.

Unless a problem could be parallelized in SIMD fashion, the ILLIAC would be no faster than any other computer, and much slower than designs from companies like Control Data. (In SIMD (Single Instruction Multiple Data) computers, a single instruction operates on many pieces of data at the same time. E.g. “multiply every number in a table by 5.”)

In order to make this as easy as possible, several new computer languages were created; IVTRAN and TRANQUIL were parallelized versions of FORTRAN, and Glypnir was a conversion of ALGOL.

Generally these languages provided support for loading arrays of data "across" the processors to be executed in parallel, and some even supported the unwinding of loops into array operations.

ILLIAC IV: A Fairchild Perspective
By Harry Sello

The evolution of the stored program computer such as ILLIAC IV came about as a result of the work of Dr. John Von Neumann, a consultant to the Manhattan Project. In 1930 Von Neumann was one of the first members of the Institute for Advanced Study (IAS) at Princeton, New Jersey where he joined Albert Einstein. Von Neumann, Hungarian by birth, became a naturalized US citizen in 1937.

During his work at Los Alamos, he had several meetings with Eckert and Mauchly discussing their work on EDVAC which was to be the successor to ENIAC. Von Neumann introduced the idea of a stored program, parallel memory, binary processor which was a great improvement over the ENIAC.

At IAS, Von Neumann recommended the construction of a stored program computer. It was built in 1953 by the RAND Corporation at the IAS and was fondly known as the Johnniac.

Other institutes and

Continued on next page

A picture is worth a thousand words but it uses up a thousand times the memory.

universities obtained grants to build copies of the computer including the ILLIAC at the University of Illinois at Urbana, Illinois. A series of seventeen versions were built at a variety of locations in different places over the world. None of these, however, could share programs with one another.

The trend toward computers in the semiconductor industry was recognized early-on by Dr. G. E. Moore, Director of Fairchild Semiconductor R&D Division. He foresaw the trend for lower cost, high speed memory components and systems. In 1963, Moore established a Digital Systems Department to develop a computer memory system. It was directed by Rex Rice, a computer engineer from IBM who was charged to learn about new computer architectures and packaging technologies. A large number of circuit and system engineers as well as semiconductor device developers were recruited from IBM, Philco and Zenith.

As Director of Memory Systems at Fairchild during 1970-72, Rice was responsible for the design and production of the world's first large semiconductor memory system -- which was the 8-million bit ILLIAC IV LSI memory. Also included was the two million byte LSI memory system for the IBM System /360 model 67.

Rex Rice's work can be seen in the Memory Section of the Computer History Museum displayed in the actual Fairchild Semiconductor Memory unit of the ILLIAC IV system. Within the unit are the 256-bit bipolar memory ICs.

The processing unit of the ILLIAC IV (not shown in the exhibit) was composed of LSI bipolar ECL integrated circuits. These were added by the University of Illinois and the Burroughs Corporation.

At Fairchild, Rice created SYMBOL, the first operational computer language, a direct hardware-implemented high-level language. He was also a co-inventor of the Dual-Inline IC package (DIP) which became a standard throughout the semiconductor industry.

A Fortran Anniversary

On September 20, 1954, Harlan Herrick ran the first FORTRAN program. This wonderful first FORTRAN compiler was designed and written from scratch in 1954-57 by an IBM team lead by John W. Backus and staffed with super-programmers like Sheldon F. Best, Harlan Herrick, Peter Sheridan, Roy Nutt, Robert Nelson, Irving Ziller, Richard Goldberg, Lois Haibt and David Sayre. By the way, Backus was also system co-designer of the computer that ran the first compiler, the IBM 704.

The new invention caught on quickly. It was no wonder, programs computing nuclear power reactor parameters took now hours instead of weeks to write, and required much less programming skill. Another great advantage of the new invention was that programs now became portable.

Fortran won the battle against assembly language and was adopted by the scientific and military communities and used extensively in the space program and military projects.

The phenomenal success of the FORTRAN team, can be attributed in part to the friendly non-authoritative group climate. Another factor may be that IBM management had the sense to shelter and protect the group, even though the project took much more time than was first anticipated.

Von Neumann on Fortran

In the 1950's John von Neumann was employed as a consultant to IBM to review proposed and ongoing advanced technology projects.

One day a week, von Neumann "held court" at 590 Madison Avenue, New York. On one of these occasions in 1954 he was confronted with the FORTRAN concept; John Backus remembered von Neumann being unimpressed and that he asked, "Why would you want more than machine language?"

Frank Beckman, who was also present, recalled that von Neumann dismissed the whole development as, "but an application of the idea of Turing's `short code'."

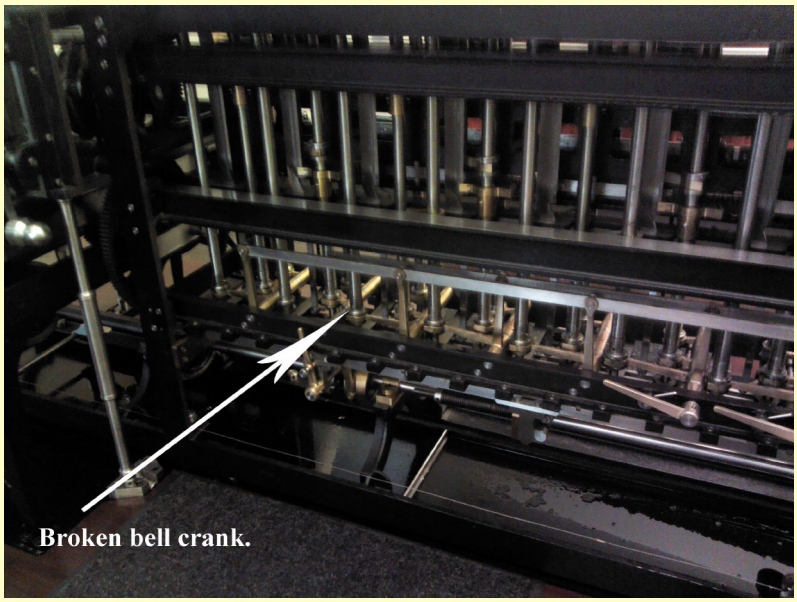
Donald Gillies, one of von Neumann's students at Princeton, and later a faculty member at the University of Illinois, recalled in the mid-1970's that the graduates students were being "used" to hand assemble programs into binary for their early machine (probably the IAS machine). He took time out to build an assembler, but when von Neumann found out about it, he was very angry, saying (paraphrased), "It is a waste of a valuable scientific computing instrument to use it to do clerical work."

Broken Part on Babbage

By Tim Robinson

As you may know, in late August, the Babbage Engine suffered a breakage of a critical part, one of the bell cranks which lift the sector columns in and out of engagement. Since then we have been able to offer visitors only limited demonstrations of the printer section, but this still generates a lot of interest and we show features which were not normally operated in the full demonstrations.

The broken part was a custom bronze casting for which there are no available spare parts and a new part has to be fabricated. The Engine's owner Nathan Myhrvold is aware of the situation and we will be working with him to restore the Engine to its authentic state.



Broken bell crank.

In the mean time, with he help of Museum volunteer Bob Feretich (who usually works with the 1401 team) we have machined a temporary replacement part which was installed Thursday. This part will allow us to fully debug the issue which caused the breakage, before installing the permanent replacement, and it should allow us to resume our normal demonstrations. We will keep you informed.

Coming Events

Date	Day	Time	Event
Sept. 21	Wed.	6:00 PM 7:00 PM	Reception Program: Venture Capital in the Valley: Past, Present & Future
Oct 15	Sat.		Opening of the new exhibition: *An Analog Life: Remembering Jim Williams* training on Wednesday Oct 12
Oct. 25	Tues.	6:00 PM 7:00 PM	Reception Worm: The First Digital World War. Author Mark Bowden and Microsoft's T.J. Campana in Conversation with John Markoff of The New York Times
Nov. 5	Sat.	02:00 PM	The Challenge and Promise of Artificial Intelligence, a Bay Area Science Festival Wonder Dialog
Nov. 8	Tues.	6:00 PM 7:00 PM	Member Reception The Technology of Animation -- DreamWorks Animation's Jeffrey Katzenberg and Ed Leonard will kick off this series, in a conversation moderated by HP's Phil McKinney.

Please contribute to the Computer History Museum Volunteer Information Exchange.

Share your stories, your interesting facts (and factoids) and your knowledge.
Send them to Jim Strickland (Jlstrick@aol.com)