1954 The IBM 701

Speed is the Game

The IBM 701 computer was delivered to the Laboratory in 1954—it was five to six times faster than its predecessor, the Univac-1.

Delivery of the IBM 701 in 1954 dramatically improved the Laboratory's capability to perform scientific calculations. With 72 cathode-ray tubes, 2,048 words of memory, and accompanying gadgetry, the machine was the first commercially successful "scientific" supercomputer because of its speed. It was five to six times faster than its predecessor, the Univac-1, which the Laboratory acquired during its first year of operation. The Univac-1 correctly predicted the Eisenhower landslide victory in the 1952 presidential election with only 7 percent of the vote tallied, but Livermore's needs quickly outgrew the machine's capabilities.

Even before the Laboratory was a reality, founders Ernest O. Lawrence, Edward Teller, and Herbert York understood the need for mammoth amounts of computing power. Almost from the opening of the doors in 1952, a sizable team of Livermore people was learning to use the Univac-1 and troubleshoot its problems. At election time, the machine earmarked for Livermore was loaned to a TV network to predict the results. Acquisition of the Univac-1, and soon after the IBM 701, marked the beginning of the Laboratory's not-so-coincidental links to commercial supercomputing—their nearly identical birth dates, efforts to develop the fastest and most powerful machines, and use of machines to solve large, complex problems.

The IBM 701 and all of Livermore's subsequent computers have been developed in part at the Laboratory's encouragement. The IBM 701 was the last vacuum-tube model before magnetic core and transistor memory. With the change in technology to transistors, computer speed and storage capacity have rapidly advanced in accordance with a phenomenon dubbed "Moore's Law," formulated in 1965 by Gordon Moore, founder of Intel Corporation. The law has accurately described the trend that every 18 months technology advances have doubled the number of transistors that could be put on a computer chip. Whether the law will continue to hold is uncertain; one possibility is the use of extreme ultraviolet lithography (see Year 1999).

Through the 1980s, Moore's Law drove processor speed but not fast enough to meet the supercomputing needs for science-based stockpile stewardship. DOE launched the Advanced Simulation and Computing Initiative (ASCI) in 1995. ASCI and its successor, the Advanced Simulation and Computing Program, pushed the development of supercomputers that use thousands and now millions of processors working in parallel in increasingly complex machine architectures. The IBM Sierra machine, which is being delivered to Livermore in 2017–2018, will provide more than 120 petaflops (10^{15} floating-point operations per second) peak performance—300 trillion times faster than the Univac-1 (see Year 2017).

Livermore's petascale—and planned for exascale (10^{18})—computing capabilities keep the Laboratory at the forefront of scientific computing in the early 21st century. They promise to help experts maintain the nation's nuclear deterrent and open many new avenues of scientific discovery.

Delivered in May 1960, the building-size LARC (Livermore Advanced Research Computer) was built by Remington Rand to specifications provided by the Laboratory.

The Origin of FORTRAN

The Univac-1 was a simple computer to program in machine language; however, the IBM 701 was more difficult to use—one reason was its reliance on punch cards for input and output. Programmers in companies and laboratories that owned 701s talked among themselves informally, resulting in various "home-brewed" systems. IBM soon began to develop a higher level language, FORTRAN (formula translation), and the Laboratory sent Robert Hughes to IBM for an extended visit to contribute to the effort. The original FORTRAN manual lists four contributors; one of them was Robert Hughes.