SEYMOUR CRAY

Seymour Cray, an electrical engineering graduate of the University of Minnesota, was an electrical engineer and supercomputer architect who designed a series of computers that were the fastest in the world for decades. He was the architect behind the design of a series of computers, each faster by a multiple than previous designs. He has been credited with creating the supercomputer industry.

Called "the father of supercomputing," for four decades he was the acknowledged leader in the high performance computer industry. Largely the result of his efforts, at one time Minnesota was known as the computer capital of the world.

Seymour Roger Cray Jr., was born September 28, 1925, in Chippewa Falls, Wisconsin. His father was the city engineer and his mother a homemaker. His parents fully supported his scientific interests, providing him with a basement laboratory equipped with chemistry sets and radio gear. They permitted young Seymour to tinker into the wee morning hours.

Seymour 's early aptitude for electronics was evident when he wired his basement laboratory to his bedroom and included an electric alarm that sounded whenever anyone tried to enter his room. By age 10, using Erector Set parts and an old motor, he built an automatic telegraph machine that could translate punched paper tape into Morse code signals. At Chippewa Falls High School, when the physics teacher was sick, he taught the class. Legend has it that he knew more about the subject than the teacher.
Seymour served in the Army during the final years of World War II, first as a radio operator in a communications platoon with the infantry in Germany, then in the Philippine Islands supporting the Philippino Guerilla army routing the remnants of the Japanese Navy out of the jungle. After his military service, he received his bachelor's degree in electrical engineering in 1950 and a master's degree in applied mathematics the next year. Fellow students recall his ability to quickly solve complex problems. He was, by all accounts, a 100% all-American nerd.
Engineering Research Associates. He began his career working at the first computer company in America, Engineering Research Associates in St. Paul. ERA was formed out of a former United States Navy lab that had built code breaking machines. It was started by William C. Norris, who later founded Control Data Corporation (CDC). Operating from the converted glider factory in St. Paul, Norris and his team built cryptographic equipment for the Navy.
ERA was among a small group of firms on the cutting edge of the commercial computer industry. There were no computers around when Seymour joined ERA in 1951, at age 26. The commercialization of the "electronic brain" was just beginning. When asked about the atmosphere at ERA in those early days, Seymour said: "It was the blind leading the blind. There were people all hired within a year because the facility was only that old. I quickly discovered in a few months that there wasn't much there. It was on to inventing from that point."
Barely a year and a half after Seymour joined the company, he was regarded as an expert on digital computer technology and was made project engineer for the successful UNIVAC (Universal Automatic Computer) 1103, the first electronically digital computer to be used for ordinary business applications. It was the first computer for which he was credited with design work.
UNIVAC 1103. The 1103 used electrostatic storage, consisting of 36 Williams tubes, named for their English inventor. Each tube was five inches in diameter. The magnetic drum memory was about 24 inches in diameter and about four feet long. The computer weighed 17 tons and required 45,000 watts of power. It was one of the largest computers in the world, occupying 1,000 square feet. It had a paper tape input and output, and could carry out 50,000 operations per second. The first one was sold to the Air Force in 1953 for use at Eglin Air Force Base (Florida) in its ballistic missile program.
The redesigned 1103A was a large machine, using 3900 vacuum tubes (plus 470 in each memory cabinet) and taking up 58 by 30 feet of floor space. A typical 4096-word system cost $950,000, and an additional memory cabinet cost $200,000.

Control Data Corporation. ERA was bought by Remington Rand and then by the Sperry Corporation in the early 1950s, and became part of the Sperry Rand Corporation. Norris balked at the bureaucracy. In 1957, he set up Control Data Corporation in a rented corner of a warehouse across the river in Minneapolis. Bill Norris recruited Seymour to work for him, and they set out to make affordable computers.

CDC 1604. Seymour designed the first computer for the CDC, the 1604. It was one of the first computers to replace hot, bulky vacuum tubes with smaller, cooler transistors. Money was short, so the resourceful Seymour shopped at an electronics outlet store and bought the transistors for 37¢ each. Although the transistors were of diverse circuitry, he successfully replaced the cumbersome and expensive tubes and radio "valves" which were then standard in the industry.

When asked about the transistor innovation, Seymour responded: "A part that I enjoy remembering is transistors were very expensive in those days because they were new. At this point I'm just beginning the Control Data 1604 Computer. It was the first computer for that company. I discovered that the local retail store in Minneapolis was selling reject transistors at a very low price compared to what you buy from the factory. I was able to buy all of them that they could get. After a few months, I was visited by the company representative who said I'm sorry but you've used all the rejected transistors we have and we can't afford to sell you the new ones at that price. I had exhausted the entire world supply of reject transistors for transistor radios in building my first computer."

The first 1604 was delivered to the US Navy in 1960 for applications supporting major Fleet Operations Control Centers in Hawaii, London, and Norfolk, Virginia. The 1604 was critical to the financial success of Control Data Corporation. It is one of the first commercially successful transistorized computers. It was immensely successful as a tool for scientific research because it was one of the first large scientific computers that was transistorized.

Legend has it that the 1604 designation was chosen by adding CDC's first street address (501 Park Avenue) to Cray's former project, the ERA-Univac 1103. The official CDC explanation for the number 1604: the original goal was to support 16K of memory and 4 tape units.

Seymour wanted an absolutely quiet work environment with a minimum of management interference. Like Norris, Seymour found corporate bureaucracy an annoyance. Norris once asked him to develop a five-year plan for CDC. The result: "Five-year goal: Build the biggest computer in the world. One-year goal: Achieve one-fifth of the above."

As CDC grew Seymour found himself constantly interrupted. In 1962, he demanded a laboratory be built for him 100 miles east of Minneapolis, on a river bluff in Chippewa Falls. After some debate, Norris backed him and set up a new laboratory on land Seymour owned in his hometown of Chippewa Falls. Part of the reason for the move may also have to do with Seymour's worries about an impending nuclear war, which he felt made Minneapolis a serious safety concern. His house, built a few hundred yards from the new CDC laboratory, included a huge bomb shelter.

CDC 6600. In the Chippewa Falls laboratory, Seymour and a small team developed the CDC 6600, the world's first commercially available computer capable of executing 3 million program instructions per second – far ahead of IBM's market-leading 7094 processor. The trick was the 6600's stripped-down internal design, which some experts view as the first use of reduced instruction-set computing (RISC). Now, more than 25 years later, RISC is being touted as a "revolution" in computing.

The CDC 6600 was the first to employ a Freon cooling system to prevent its 350,000 transistors from overheating. Released in 1964, is generally considered the first supercomputer.

The CDC 6600 inspired awe - even from a begrudging Thomas J. Watson Jr., then chairman of IBM. He grew incensed when he saw puny CDC besting his legions of engineers and scientists. "Big Blue" had just invested millions into developing a high-performance computer whose relatively poor performance damaged IBM's reputation with leading scientific customers. Watson wrote a memo asking how IBM lost "our industry leadership" to a company with "34 people, including the janitor." "Of these, 14 are engineers and 4 are programmers."

CDC 7600. The 6600 was followed by the CDC 7600 computer, introduced in 1969, that was about five times faster than the 6600. Capable of 15 million computations per second, it furthered CDC s lead in scientific computing.

Cray Research. In 1972, Seymour formed Cray Research, a company devoted entirely to the development of supercomputers. When the person in charge of financing looked for seed capital, he was surprised to find that Seymour's reputation was well known. The financial world was very willing to provide the money needed to develop a new machine.

CRAY-1 supercomputer. After four years of work, with a handful of helpers, the CRAY-1 supercomputer was unveiled in 1976. It was a uniprocessor with vector capabilities. Vector processors are built primarily for large scientific and engineering calculations. A vector processor performs computations on more than one number or set of data simultaneously. The CRAY-1 was one-fourth the size of the CDC 7600 and could do10 times the work, and quickly unseated the CDC 7600 as the leading computer for scientific research. The first CRAY-1 system was installed at Los Alamos National Laboratory in 1976, for a six-month trial, and it went on to become one of the best known and most successful supercomputers in history.

The National Center for Atmospheric Research was first official customer of Cray Research in 1977. The investors earned back their original investment of $8.6 million in 1976 when the system was sold for $8.8 million. The company's early estimates had suggested they might sell a dozen such machines, based on sales of similar machines from the CDC era, so the price was set accordingly. But in the end well over 100 CRAY-1s were sold, and the company was a huge financial success. In general, the CRAY-1 beat anything on the market by a wide margin.

To increase the speed of the system, the CRAY-1 had a unique "C" shape which enabled integrated circuits to be closer together. No wire in the system was more than four feet long. It was the first commercially successful vector processor, executing not one, but up to 32 arithmetic operations at a time. It boasted a world record speed of 160 million floating-point operations per second (160 megaflops) and an 8

megabyte (1 million word) main memory. The initial model, the Cray-1A, weighed 5.5 tons including the Freon refrigeration system.

The CRAY-2 system was marketed in 1985, and featured a phenomenal 2-billion byte memory that could perform 1.2 billion computer operations per second, a tenfold performance increase over the CRAY-1.

While not commercially successful, the CRAY-3 demonstrated reliable operation at a 500 MHz clock speed. When the Cray-3 project went over-budget it was spun off to a new company, Cray Computer Corporation. Only one Cray-3 was delivered, in 1993.

His last system, the CRAY-4, was operating at a clock rate of 1 GHz and was nearing completion before Seymour had to abandon the project in 1994. By 1995, there had been no further sales of the CRAY-3, and the ending of the Cold War made it unlikely anyone would buy enough CRAY-4s to offer a return on development funds. The company ran out of funds and Cray Computer was liquidated in bankruptcy in June 1995.

S.C. Computers. Seymour established another company, S.C. Computers (named for his initials), intending to design a new massively parallel machine. Design on the machine had just started when he died October 5, 1996 at the age of 71, from neck and back injuries sustained in a car accident two weeks earlier.

For two decades Seymour Cray 's computers were mainstays to government researchers studying nuclear weaponry. Seymour told Science magazine in 1978 that: " ... the ability to test bombs on a computer seems to me to be the vehicle that led to the [1963] Test Ban Treaty, and as long as we can keep it on a computer no one will get hurt."

Seymour sometimes joked that he was more a plumber than an engineer, because much of his computer design work consisted of crafting cooling systems to keep the hardware from overheating and ensuring that the computer would neither boot nor operate if the cooling system malfunctioned.

Seymour liked to work with fundamental and simple tools; generally only a pad of paper and a pencil. But some of his work required more sophisticated tools. Once when told that Steven Jobs had just bought a Cray computer to help design the next Apple computer, Seymour said he had just bought a Macintosh computer to help design the CRAY-3.

Seymour's systems were masterpieces of technology and esthetic design. A devoted fan of "Star Trek," a 1960s television show about space travel, Cray included aesthetically pleasing touches in his computers, such as transparent blue glass that revealed their inner workings.

Seymour regarded every system he worked on as a stepping stone to the next. And most of them were foundations for other systems built by others using his basic designs. In an interview a few years before his death, he said, "For the last 30 or 40 years I've been getting my insights from the customers who bought the Cray computers. They would tell me what's wrong with it. I'd address those issues and we'd go another generation. It's been very evolutionary. Essentially every machine I've designed since that first day have been clear descendants of one another in their structure."

Joel Birnbaum, then with the Hewett Packard Company, said of him: "It seems impossible to exaggerate the effect he had on the industry; many of the things that high performance computers now do routinely were at the farthest edge of credibility when Seymour envisioned them."

Cray's legacy lives on in awards like the Seymour Cray Computer Engineering Award, established in late 1997, and sponsored by the IEEE Computer Society. It is awarded to recognize innovative contributions to high performance computing systems that best exemplify the creative spirit demonstrated by Seymour Cray.

Note: This biography has been compiled from information in the nomination form submitted to the Minnesota Inventors Hall of Fame and from information available on the Internet and a variety of other sources.