In Memoriam

Claude Elwood Shannon, the father of information theory, died on February 24, in Medford, MA, after a long battle with Alzheimer's disease. Shannon, an AES member, received the Gold Medal Award in 1985. A mathematician and computer scientist whose theories laid the groundwork for electronic communications networks, Shannon was 84 years old.

Born in Petoskey, MI, in 1916, Shannon received a bachelor's degree in mathematics and electrical engineering from the University of Michigan in 1936. He earned a master's degree in electrical engineering and a Ph.D. in mathematics from M.I.T. in 1940. While at M.I.T., he worked with Vannevar Bush on one of the early calculating machines, the "differential analyzer."

Shannon quickly made his mark with digital electronics. In his master's thesis, he showed how Boolean logic, in which problems can be solved by manipulating just two symbols, 1 and 0, could be carried out automatically with electrical switching circuits. The symbol 1 could be represented by a switch that was turned on; 0 would be a switch that was turned off.

George Boole, the 19th-century British mathematician who invented the two-symbol logic, grandiosely called his system "The Laws of Thought." The idea was not lost on Shannon, who realized early that, as he once put it, a computer is "a lot more than an adding machine." The binary digits could be used to represent words, sounds, images — perhaps even ideas.

Shannon understood the power that comes from encoding information in a simple language of 1's and 0's. As a young man, Shannon wrote two important papers in the fields of computer science and information theory.

His later work on chess-playing machines and an electronic mouse that could run a maze helped create the field of artificial intelligence. His thesis, "A Symbolic Analysis of Relay and Switching Circuits," was largely motivated by the telephone industry's need to find a mathematical language to describe the behavior of the complex switching circuits that were replacing human operators. The implications of the paper were far broader, laying out a basic idea on which all modern computers are built.

The year after graduating from M.I.T. Shannon took a job at AT&T Bell Laboratories in New Jersey.

In 1948, Shannon published "A Mathematical Theory of Communication," giving birth to the science called information theory. The motivation again was practical: how to transmit messages while keeping them from becoming garbled by noise.

To analyze this problem properly, he realized he had to come up with a precise definition of information. The information content of a message, he proposed, has nothing to do with its content but simply with the number of 1's and 0's it took to transmit it. This was a jarring notion to a generation of engineers accustomed to thinking of communication in terms of sending electromagnetic waveforms down a wire. The nature of the message did not matter — it could be numbers, words, music, video. Ultimately it was all just 1's and 0's.

Today, when gigabytes of movie trailers, Napster files and e-mail messages course through the same wires as telephone calls, the idea seems elemental. But it has its roots in Shannon's paper, which contains what may be the first published occurrence of the word "bit." He also showed that if enough extra bits were added to a message, to help correct for errors, it could tunnel through the noisiest channel, arriving unscathed at the end. This insight has been developed over the decades into sophisticated error-correction codes that ensure the integrity of the data on which society interacts. In later years, his ideas spread beyond the fields of communications engineering and computer science.

He is survived by his wife, Mary Elizabeth Moore Shannon; a son, Andrew Moore Shannon; a daughter, Margarita Shannon; a sister, and two granddaughters.