Claude Elwood Shannon

Claude Elwood Shannon was born in Petoskey, Michigan on April 30, 1916. His father Claude Elwood Shannon Sr.(1862-1934) was a businessman and his mother Mabel Wolf Shannon (1880-1945) was for a number of years, Principal of Gaylord High School in Gaylord, Michigan, which Shannon attended and graduated from in 1932.

Shannon's special talents in mathematics and engineering were evident right from childhood. His best subjects in school were science and mathematics. At home, he constructed all kinds of devices, ranging from radio-controlled boats to telegraph systems that used barbed wire from the fence of a nearby pasture.

Following his sister Catherine, a mathematician, Shannon joined the University of Michigan in 1932 and graduated in 1936 with degrees of Bachelor of Science in Electrical Engineering and Bachelor of Science in Mathematics. In 1936 he joined the Department of Electrical Engineering in the Massachusetts Institute of Technology as a research assistant. He was first involved in the operation of the Bush differential analyser, an extremely advanced analog calculating machine of that era, used for solving differential equations. A part of the analyser was a relay circuit, which stimulated his interest in the underlying theory.

During his undergraduate days Shannon had studied symbolic logic and Boolean algebra, and he now realized that he had the proper framework for the study of switching circuits. His paper entitled 'A symbolic analysis of relay and switching circuits' appeared in 1938 and was later awarded the Alfred Nobel Prize of the combined engineering societies of the United States. This work was the foundation for a systematic theory of digital circuit design.

In 1938 Shannon shifted from the electrical engineering department to the mathematics department. He spent the summer of 1939 at Cold Spring Harbour working under the geneticist Barbara Burks. It was here that he developed the ideas for his PhD thesis entitled 'An algebra for theoretical genetics' under the supervision of Frank L Hitchcock, an algebraist.

In 1940 Shannon received, both, the SM degree in Electrical Engineering and the Doctor of Philosophy in Mathematics. After a years stint at the Institute of Advanced Study at Princeton in 1940-41, working with Herman Weyl, Shannon joined a team at Bell Laboratories working on anti-aircraft directors. During the next few years at Bell Labs, he was in the company of first rate mathematicians and scientists – John Pierce, a pioneer in satellite communications, Harry Nyquist, the expert in signals, Hendrik Bode, well-known control theorist, John Bardeen, William Shockley and Walter Brattain, co-inventors of the transistor, and many others. It was here that he met and married Mary Elizabeth Moore, a numerical analyst in John Pierce's group. They had three children.

Shannon's most important scientific contribution was his work on communication. In 1941 he began a serious study of communication problems, partly motivated by the demands of the war effort. This research resulted in the publication of the paper entitled, 'A mathematical theory of communication' in 1948. This pioneering paper begins by observing that 'the fundamental problem of communication is that of reproducing at one point either exactly or approximately, a message selected at another point'. He defined the information content of a message in terms of binary digits. The results were so breathtakingly original, that it took some time for the mathematical and engineering community to realize their significance. A brand-new science had been created with the publication of that single paper, and the framework and terminology he established remains standard even today.

Shannon's 1949 paper entitled 'Communication theory of secrecy systems' was a fundamental paper in cryptography and was responsible for transforming it from an art to a science.

During a World War II visit to the United States, Alan Turing, a leading British mathematician, spent a few months at Bell Labs working with Shannon. Both scientists were interested in the possibility of building a machine that could imitate the human brain. They also worked together to build an encrypted voice phone that would allow Roosevelt to have secure transatlantic conversations with Churchill.

Shannon made interesting and innovative contributions to the area of artificial intelligence. He wrote a paper entitled 'Programming a computer for playing chess' in 1950, and developed a chess playing computer. Many years later, in 1965, he met the world chess champion Mikhail Botvinnik (also an electrical engineer), and played a match with him, but lost after 42 moves.

In 1956 Shannon was invited to be a visiting professor at the Massachusetts Institute of Technology. In 1958 he became Donnor Professor of Science, and Professor Emeritus in 1978.

Shannon's interest did not stop with academics. He was an expert juggler who was often seen juggling three balls while riding an unicycle. He designed a machine to solve the Rubik cube, juggling machines, a mechanical mouse called Theseus that could navigate a maze, and a host of clever mechanical devices which he delighted in showing to his visitors. He was an accomplished clarinet player, and was even known to pen light verse.

Shannon's published and unpublished documents (a hundred and twenty seven of them), cover an unbelievably wide spectrum of areas. Many of them have been a priceless source of research ideas for others. One could say that there would be no Internet without Shannon's information theory – every modem, every compressed file, every error-correcting code owes something to Shannon.

Shannon was the recipient of numerous honorary degrees and awards. He died on February 24, 2001 in Massachusetts after a long battle with Alzheimer's disease.

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