Remembering Claude Shannon

Submitted July 7, 2002, 2:24 PM

What are your most vivid memories of Claude Shannon?

When asked (newsgroup sci.math 27july02) to vote for : Re: The best 20th Cent. mathematician (vote here) I replied without hesitation: " Claude Shannon, who looked further than mathematics, to 'discover' (as MSc student MIT '38) Boolean Algebra (then some 90 yrs old;-) as natural model for digital circuit behaviour. And 10 years later he founded the discipline of information theory - by linking discrete and continuous math branches (discrete data transmission, algorithmic complexity and probability theory / entropy). His own comment on this: "It just happened that no-one was familiar with both fields at the same time." He was a master of interdisciplinary search-and-find, guided by a fabulous intuition for which theoretical concept is essential *and* practical (often by specialists dismissed for detailed further development - as being 'trivial' . . .) -- NB - http://home.iae.nl/users/benschop/search.htm http://home.iae.nl/users/benschop/links.htm : re the ECHO project on the history of Science (gmu.edu)

How did Claude Shannon affect your own work?

My research (in industry) is in design-automation methods for digital VLSI. And although an EE by training (TU-Delft .nl, U-Waterloo .ca), my interest shifted through the years towards disctrete mathematics. Especially the associative algebra of function composition ('semigroups') applied to structural analysis and synthesis of FSM's (finite state machines), thus sequential logic. This includes arithmetic - with associative and commutative operations (+) and (*) - as well as Boolean logic (set theory, with intersect and union as associative commutative and idempotent operations) - in a straightforward 3-level hierarchy. Shannon's first main result in his MSc thesis (1938) as described above, always inspired me as a prime example of a math-concept that is available but not used in practice, thus not seen to be essential for engineering purposes. Another hero of mine, of an earlier century, is Fourier - with his frequency spectrum (1807, 1824) for an equivalent representation of time-varying signals : an indispensible tool, without which (electrical) engineering as we know it would not be possible. Being now in the 'digital age' (of computers) for well over half a century, it is amazing to me that there is still no formal "digital network theory" - at least not at a practical level comparable to "linear network theory" (with known five basic components R, L, C, Trafo, Gyrator) and synthesis tools based on conservation principles such as Kirchoff's laws, and linear techniques like the Fourier spectrum, convolution, etc. What Shannon did for combinational logic synthesis (recognizing a math-concept as indispensible tool for digital circuit engineering) is an inspiration for me regarding sequential

logic synthesis (essentially: FSM synthesis) based on the already some 75 years old structure theory of finite semigroups (as sequential closure of any FSM) - available in the PhD thesis of another student : Suschkewitch (Kiev, 1928) [1] regarding the detailed structure of finite simple semigroups (viz. having no proper ideal). This is, for all practical purposes, an essential step beyond 'almighty' group theory (re [2] : on the five basic state machine types, as components of any digital network). [1] A.Clifford, G.Preston : "The Algebraic Theory of Semigroups", AMS survey #7 (1961), appendix A, p 207. [2] N.Benschop : http://arXiv.org/abs/math.GM/0103112

Name

Nico Benschop

Submitted November 11, 2001, 10:45 AM

What are your most vivid memories of Claude Shannon?

We never met, but I have now interviewed many people who knew or worked with him.

How did Claude Shannon affect your own work?

I am currently producing a documentary for UC-TV (University of California)from San Diego on Claude Shannon and his legacy. We staged a Shannon Symposium in October and interviewed leading scholars in the field of information theory. We are now looking for video or film clips or photographs of Shannon at different stages of his career for inclusion in the documentary (with help from his widow Betty). If anyone has visuals of Claude Shannon, please give me a call at (858) 822-5825 or email at dramsey@ucsd.edu. Thanks.

Name

Doug Ramsey/UCSD

Submitted September 9, 2001, 10:15 PM

What are your most vivid memories of Claude Shannon?

The following is the text from my website: http://www2.bc.edu/~lewbel/Shannon.htm see also my home page http://www2.bc.edu/~lewbel/ In addition to this text, that website includes photo's, illustrations, & a rare video of claude. Unlike most other contributors here, I knew Claude primarily through his work in juggling. A PERSONAL TRIBUTE TO CLAUDE SHANNON Note: excerpts of this tribute appeared in the May/June 2001 issue of 'Juggle' magazine. Reprinted by permission. By Professor Arthur Lewbel March, 2001. Claude Elwood Shannon 1916-2001. Survived by his wife Mary Elizabeth (Betty) Shannon, a son, Andrew Shannon, and a daughter, Margarita "Peggy" Shannon. Many Jugglers have heard about the juggling robot invented by Claude Shannon, and jugglers of a mathematical bent will know of Shannon's juggling theorem. However, among mathematicians and computer scientists, Claude Shannon is a legend, widely recognized as one of the most brilliant men of the twentieth century. It is impossible to overstate his importance in the early development of computers and digital communication. In 1990, Scientific American called his paper on information theory, "The Magna Carta of the Information Age." In the 1980's Claude quietly showed up at a computer science lecture (after having been away from the field for many years). One attendee said, "It was as if Isaac Newton had showed up at a physics conference." When people realized who he was they pushed him on stage. He gave a very short speech, then juggled a bit. Afterwards, attendees lined up to get his autograph. Any encyclopedia will give you a short biography of Claude's life, and thousands of books, articles, and webpages exist describing his work in math and computer science. I will therefore skip most of that, and instead provide my own recollections and impressions of an extraordinary man. I first met Claude at the MIT Juggling club. One nice thing about juggling at MIT is that you never know who will show up. For example, one day Doc Edgerton, inventor of the strobe light, stopped by the juggling club and asked if he could photograph some of us juggling under strobe lights. So it wasn't a great surprise when a cheerful, gray haired professor stopped by the club one afternoon and said to me, "Can I measure your juggling?" That was my introduction to Claude Shannon. Not long after, the MIT juggling club decided to have a video and pizza night, and needed someone with a big TV, in a room large enough to hold dozens of jugglers. We all ended up in Claude's living room, in a stately home (originally owed by Thomas Jefferson's great granddaughter) overlooking a lake in Winchester, Massachusetts. Another time he invited me to dinner at his house, saying only that, "he had another juggler coming over as well." The other guest turned out to be Albert Lucas. Unlike most brilliant theoretical mathematicians, Claude was also wonderfully adept with tools and machines, and frequently built little gadgets and inventions, usually with the goal of being whimsical rather than practical. "I've always pursued my interests without much regard to financial value or value to the world. I've spent lots of time on totally useless things," Shannon said in 1983. These useless things would include his juggling robot, a mechanical mouse that could navigate a maze, and a computing machine that did all its calculations in roman numerals. Claude never did care about money. He never even put his paycheck into a bank account that paid interest, until he married and his wife Betty suggested it to him. Still, he became a very wealthy man, partly as a result of early investments with some of his computer scientist pals, including the founders of Teledyne and of Hewlett Packard. When he did think about finance, Claude was as brilliant at that as with anything else he set his mind to. Knowing I was an economist, he once explained to me his thoughts on investing. Some were wonderfully practical, as when he said he'd always buy stocks rather than gold, because companies grow and metals don't. Some were more esoteric, for example, he had ideas regarding mean-variance analysis that jibe well with many aspects of modern portfolio theory. Some of the juggling artifacts that Claude had in his large 'toy room:' A zoetrope made of a dozen little still figures of juggling clowns. Spin it, and they look like one

clown juggling. A sculpture of a juggler, juggling 3 jugglers, each of whom is juggling three jugglers. His famous juggling robot, complete with the head of W. C. Fields stuck on top. A mechanical diorama that shows three clowns, juggling many balls rings and clubs. The props move so realistically that the clubs even rotate and land correctly (triple spins, if I remember right). In the basement was an air hockey table, mounted at an angle, for two dimensional, low gravity juggling. And in the garage, a collection of exotic unicycles. In addition to his famous juggling theorem, Claude came close to inventing site swaps. In the 1970's, he was asked by Scientific American magazine to write an article about juggling. In addition to including his juggling theorem, the draft of his article contained an attempt to count the number of different possible juggling patterns. Scientific American asked him to revise the article, but by then he was doing other things and never bothered to finish it. (A copy of his draft article can be found in the book, "Claude Elwood Shannon Collected Papers," edited by N.J.A. Sloane and A. D. Wyner, New York, IEEE Press, 1993, pages 850-864). He made an offhand remark that maybe I should write an article for them instead. Years later, I took his advice (see, "The Science of Juggling, Scientific American, Nov. 1995). Claude told me this story. He may have been kidding, but it illustrates both his sense of humor and his delightfully self deprecating nature, and it certainly could be true. The story is that Claude was in the middle of giving a lecture to mathematicians in Princeton, when the door in the back of the room opens, and in walks Albert Einstein. Einstein stands listening for a few minutes, whispers something in the ear of someone in the back of the room, and leaves. At the end of the lecture, Claude hurries to the back of the room to find the person that Einstein had whispered too, to find out what the great man had to say about his work. The answer: Einstein had asked directions to the men?s room. Claude wrote the first paper describing how one might program a computer to play chess. He wrote, "Communication Theory of Secrecy Systems, " which the Boston Globe newspaper said "transformed cryptography from an art to a science." Yet neither one of these were his greatest works. Here's my own interpretation of Claude's two most famous and important papers. His 1937 thesis basically said, "if we could someday invent a computing machine, the way to make it think would be to use binary code, by stringing together switches and applying Boole's logic system to the result." This work, done while he was still a student at MIT, has been called the most important master's thesis of the twentieth century. The idea was immediately put to use in the design of telephone switching systems, and is indeed how all modern computers think. But that was only Claude's second most important idea. His most famous paper, written in 1948 at Bell Labs, created what is now known as information theory. In "A Mathematical Theory of Communication," Shannon proposed the idea of converting any kind of data, (such as pictures, sounds, or text) to zeroes and ones, which could then be communicated without errors. Data are reduced to bits of information, and information transmission is then measured in terms of the amount of disorder or randomness the data contains (entropy). Optimal communication of data is achieved by removing all randomness and redundancy (now known as the Shannon limit). In short, Claude basically invented digital communication, as is now used by computers, CD's, and cell phones. In addition to communications, fields as diverse as computer science, neurobiology, code breaking, and genetics have all been revolutionized by the application of Shannon's information theory. Without Claude?s work, the internet as we know it could not have been created. Some of Claude?s honors include the National Medal of Science, Japan's Kyoto Prize, the IEEE Medal of Honor, and about a dozen honorary degrees. In 1998, the two building AT&T labs complex in Florham Park, N.J., was named the Shannon Laboratory. One day, almost immediately after I'd arrived at his house, Claude said to me, "Do you mind if hang you upside down by your legs?" He had realized that while bounce juggling is much easier than toss juggling in terms of energy requirements, throwing upward as in toss juggling is physiologically easier, and so he wanted to try combining

the two, which meant bounce juggling while hanging upside down. For every one invention he built or theorem he proved, he had a hundred other ideas that he just never got around to finishing. One juggling example: He showed me a vacuum cleaner strapped to a pole, pointing straight up, with the motor reversed to blow instead of suck. He turned it on, and placed a styrofoam ball in the wind current. It hovered about a foot above the vacuum. He then varied the speed of the motor, and the ball drifted up and down as the speed changed. "Now," he said, "Imagine three balls and two blowers, with the blowers angled a bit towards each other, and the motors timed to alternate speeds." The last time I saw Claude, Alzheimer's disease had gotten the upper hand. As sad as it is to see anyone's light slowly fade, it is an especially cruel fate to be suffered by a genius. He vaguely remembered I juggled, and cheerfully showed me the juggling displays in his toy room, as if for the first time. And, despite the loss of memory and reason, he was every bit as warm, friendly, and cheerful as the first time I met him. Billions of people may have benefited from his work, but I, and thousands of others who knew him a little bit, are eternally grateful to have known him as a person. "Shannon's juggling theorem" and "Shannon's juggling robot" below reprinted with permission from The Science of Juggling, By Peter J. Beek and Arthur Lewbel, Scientific American, November, 1995, Volume 273, Number 5, pages 92-97. The entire Science of Juggling article (except for some copyrighted photos) may be found here: The Science of Juggling. Shannon's juggling robot. Shannon pioneered juggling robotics, constructing a bounce-juggling machine in the 1970s from an Erector set. In it, small steel balls are bounced off a tightly stretched drum, making a satisfying "thunk" with each hit. Bounce juggling is easier to accomplish than is toss juggling because the balls are grabbed at the top of their trajectories, when they are moving the slowest. In Shannon's machine, the arms are fixed relative to each other. The unit moves in a simple rocking motion, each side making a catch when it rocks down and a toss when it rocks up. Throwing errors are corrected by having short, grooved tracks in place of hands. Caught near the zenith of their flight, balls land in the track; the downswing of the arm rolls the ball to the back of the track, thus imparting suffcient energy to the ball for making a throw. Shannon's original construction handled three balls, although Christopher G. Atkeson and Stefan K. Schaal of the Georgia Institute of Technology have since constructed a five-ball machine along the same lines. Shannon's juggling therorem JUGGLING THEOREM proposed by Claude E. Shannon of the Massachusetts Institute of Technology is schematically represented for the three-ball cascade. The exact equation is (F+D)H=(V+D)N, where F is the time a ball spends in the air, D is the time a ball spends in a hand, V is the time a hand is vacant, N is the number of balls juggled, and H is the number of hands. The theorem is proved by following one complete cycle of the juggle from the point of view of the hand and of the ball and then equating the two.

Name

Arthur Lewbel

Submitted August 8, 2001, 7:17 PM

What are your most vivid memories of Claude Shannon?

Unfortunately I joined Bell Labs from MIT just two weeks after Claude Shannon migrated in the opposite direction. I never met him until perhaps six years ago when he toured Bell Laboratories. By then sadly the onset of Alzheimer's was clear, and the really interesting technical conversations were with his extremely sharp wife--also an alumnus of Bell Labs. Working in the math department at the Labs, I of course heard plenty of Shannon stories, which you will doubtless pick up from elsewhere: How Shannon took up the unicycle and when he perfected his technique, brought it to work and issued forth to ride the 1/4-mile length of the main corridor, which filled up behind him with a buzz of gawkers. Or how when Dave Hagelbarger made his "outguessing machine", which with only 32 bits of state managed over its lifetime to predict 65% of binary choices of human opponents, Shannon set forth to do better. I believe Shannon in fact did so, but with a more complex device. But of course the towering achievements of Shannon were his master's thesis--one of those brilliant "why didn't I think of that" insights, that only have to be heard, not studied, to change one's ways of thinking. And information theory, which I took as an undergraduate at Cornell only five years after the paper appeared--incredibly quick adoption. And its application to cryptography, a subject that didn't really come into its own until the late 1970s, 30 years after Shannon showed the way. In every case, his is the defining outlook on the field. But these are familiar tales and influences. My personal Shannon story is that as a kid I used to ski on what was to become his lawn. I had lived two doors away from the old mansion on Mystic Lake that he bought when he moved to MIT. The mansion's broad lawn sloping down to the lake was the local ski and sled hill. I climbed it innumerable times, but Shannon didn't. Characteristically, this gadgeteer installed a chair lift, which I saw much later when I visited the intervening neighbor John Trump, another great MIT professor who founded High Voltage Engineering. [Tangential reminiscence: Shannon's approach to switching circuits was enshrined in the book by Keister, Ritchie, and Washburn, three Bell Labs authors who impinged on my life in various ways. On my last day at a summer job in Bell Labs at West Street, NYC, I was introduced to Bill Keister, who described the subject to me. Having learned Boolean algebra (from Max Black, the philosopher of religion!) that was all I needed to go off and do combinatorial circuit design. Ritchie was the father of Dennis, with whom I long worked on Unix, and of Bill, who founded a business, Binary Arts, which marketed logic toys that Keister had invented in his basement. Washburn, a good jazz pianist, used to play for huge Bell Labs parties held at a bachelor pad where I hung my hat for a while. I imagine Shannon had attended them before I appeared on scene--other celebrities like Dick Hamming certainly did.]

Name

Doug McIlroy

Submitted August 8, 2001, 10:55 AM

What are your most vivid memories of Claude Shannon?

We never personally met Claude Shannon. We use Shannon's work in teaching at Novosibirsk State University in several courses: a) coding theory (general theorems of coding theory and data compression, cryptology), b) discrete analysis (complexity theory, constructing of codes), c) discrete mathematics.

How did Claude Shannon affect your own work?

The remarkable scientist C.E. Shannon is no more with us, but his works will always win the hearts of all people by their originality and some peculiar novelty. His works are mostly distinguished by the combination of the deepest penetration into the essence of various problems with the masterly statement of a problem and its solution as a true mathematical problem. Discoveries made by this scientist gave a universal clue to solving problems in different fields of science starting with mathematics and technology (communication and computers) up to biology and linguistics. They originated new fields in mathematics (information theory, coding theory, complexity theory) as well as stimulated the development of earlier existing areas (theory of dynamic systems). At one time the elder mathematicians noticed that there was some special parallelism in treating obviously and greatly different problems remarked in Shannon's works and in descriptive set theory which refers to the highest sections of mathematics. It won't be an exaggeration to say that Shannon's works have a general mathematical and scientific significance. His works are remarkable not only by their results, but also by their integrity, the logical and natural development of sections into each other makes an impression that the problem is developing itself. It is the case when you can speak about the flight of thoughts and the connection of Reality with its potential of development and Inspiration that reveals this potential. Finally, Shannon surprisingly disregarded his outer success – advertising, prestige or things like that, you can feel his astonishing reserve even living on another continent. Those who long for success could object that having such a powerful potential it is easy to be modest, although lacking that special talent to a great self restraint might not lead to displaying this powerful potential. We deeply revere the memory of C.E. Shannon and hope that his outstanding works will inspire new generations of scientists.

Name

Sobolev Institute of Mathematics, Coding and Complexity Theory Groups (Yuri L. Vasil'ev, Faina I. Solov'eva, Sergey V. Avgustinovich, Elizaveta A. Okol'nishnikova, Sergey A. Malyugin, Anastasiya Yu. Vasil'eva, Denis S. Krotov, Vladimir N. Potapov)

Submitted July 7, 2001, 12:21 PM

What are your most vivid memories of Claude Shannon?

I am not a researcher in Information Theory and had little contact with Claude Shannon, but one memory stands out: I was working on the search for limits on the noise performance of linear electronic amplifiers in the 50's. I was a fledgling Assistant Professor at that time. I gave a seminar in which Claude Shannon honored me with his presence. He treated me "as his equal" in a way I shall never forget. This was his way with all junior colleagues. He asked a leading question which resulted in Chapter 4 of the monograph "Circuit Theory of Linear Noisy Networks," H. A. Haus and R. B. Adler, John Wiley and Sons, New York (1959). We thanked him in the Preface.

Name

Hermann Haus

Submitted July 7, 2001, 4:40 PM

If you have any other observations or comments, please enter them here.

In the upper part of the 'mitt' of Michigan is a small town alongside Interstate-75 called Gaylord. It's just a dinky little place in the sandy soil and piney woods. If it weren't for the Walmart on the edge of town, it likely would have faded into obscurity. They make a big thing out of their Bavarian heritage up there. Back in the 20's a young man, son of the local judge and a school marm, grew up on a farm on the edge of town. He was a very clever young man. He used to talk by morse code with his buddy on a farm a few miles away using the stretch of barbed wire in between the two farms. I imagine he also liked to pick huckleberries in the summer as so many people up there do. And, no doubt, he occasionally went along with his parents to the slightly larger town of Grayling to the south and had a sodee-pop at Dad's place while they took care of their adult business. But he was no normal Jackpine Savage. He was going places. He went on to the University of Michigan and then the Massachusetts Institute of Technology. After he got out of school, he went to work in the mathematics department at Bell Labs where he wrote a fascinating book called "A Mathematical Theory of Communications". It earned him the title of The Father of Information Theory and set the theoretical basis for virtually all of today's telecom technology - from bank machines to wireless data-transfer and much, much more. Afterwards, he went back to MIT as a professor where he was especially remembered for two things: (1) travelling around campus on his unicycle, and (2) his legendary Toy Room at home. He remained an avid unicyclist as long as he was physically capable of it. His Toy Room was home to an amazing variety of home-made automated robots. It inspired among other things, the Toy Maker in the movie "Bladerunner". Much like that character, he was a very shy and private man who was completely incapable of self-promotion. Unlike that guy, he had lots of friends. But speaking before large crowds, which he was often asked to do, terrified him. His avoidance of such occasions was often mistaken for arrogance early on until people realized what it was about. His name was Claude Shannon. He died recently at the age of 84. Truely an extraordinary man and uniquely playful and gentle American genius.

Name

Gary Harland

Submitted July 7, 2001, 4:42 PM

What are your most vivid memories of Claude Shannon?

Have never met, nor do I know C. Shannon personally.

How did Claude Shannon affect your own work?

My area of research is loosely defined as "optimal extraction of information from physical systems". Thus, the Shannon entropy of the system comes into play as a metric to insure that any estimates made are unbiased. Shannon's entropy is actually the same as the thermodynamic entropy (Jaynes) and can be applied in a rigourous physical sense. An example of which is described here: If we look at an "object" the light emission is actually the probability of photon emission per unit area, per unit solid angle per unit energy. The response of an imaging system is actually the probability of a photon entering the telescope at one angle of being diffracted into another angle and the "image" is the probability of photon collection per detector area. Thus, given the "image" and the system response we are trying to estimate the "object" - hence we are estimating a probablity density and the only unbiased estimate of the probability is that which has maximal entropy, however, if the source is also in thermodynamic equilibrium, it is also in a state of maximum thermodynamic entropy. Thus C. Shannon's work has brought some great insight into physics.

Name

Rick Lyon

Submitted July 7, 2001, 6:31 PM

What are your most vivid memories of Claude Shannon?

In the early Seventies, Claude Shannon gave a seminar at MIT on his work in investment theory. Many people were aware that in addition to everything else, Shannon was a very successful investor. Interest turned out to be so great that the seminar was moved to one of MIT's largest lecture halls, but even so the audience overflowed the room. Shannon presented some lovely theoretical results, modeling stock prices as a random walk, and showing that even if the general trend was downward, you could still make money from the fluctuations. (I don't believe that these results have ever been published.) The first question was: did Shannon use this theory for his own investments? "Naw," he replied, "the commissions would kill you."

How did Claude Shannon affect your own work?

As it happens, my career in information theory is directly due to Claude Shannon. After I did a master's thesis at MIT on information theory and quantum mechanics, I was advised that information theory was dead and that I should look elsewhere for a PhD thesis. (This was rather poor advice, of course; information theory was not dead, just getting its second wind.) After six unhappy months of looking elsewhere, I took Shannon's research seminar in the spring term. His method of teaching was to talk about problems that he was working on, partial results, conjectures, etc. Within a month I was working on some of these problems, within two months I had a thesis topic, within a year I had a thesis and a doctorate in information theory, and the rest is history.

If you have any other observations or comments, please enter them here.

Information theory is a field that has consistently attracted some of the brightest engineers who are interested both in elegant theory and in practical results. It is also a remarkably collegial and supportive field, with little of the politics and backbiting characteristic of nearby fields. I believe that these attributes are due directly to the first generation of information theorists and the tone that they set, and particularly to Shannon. Some people have called Shannon as one of the greatest mathematicians of the twentieth century. I have no problem with that description.

Name

David Forney

Submitted July 7, 2001, 9:09 AM

How did Claude Shannon affect your own work?

I never knew Dr. Shannon personally. However, it was his masters thesis that influenced me --at the age of nine--to become a mathematician! I had bought a primitive "computer kit" called "Geniac" by mail. The kit was basically a bunch of rotary switches and simple experiments. However, they bundled Shannon's masters thesis: "On the Symbolic Analysis of Switching Circuits" with it. I read it and decided to become a mathematician. It was such a clear introduction to Boolean methods that a nine year girl could understand it. Dr. Shannon changed my entire life.

Name

Professor Penelope Smith

Submitted July 7, 2001, 3:57 PM

What are your most vivid memories of Claude Shannon?

It was a vicarious meeting, in fact, two of them. A new employee was installed in my office. He was from Capetown, S.Africa. I mentioned Shannon in a conversation and I still remember the electricity. He adored Shannon and it was as if Shannon was in the room. I was awed by this and felt the Shannon presence, even though I didn't know much about him since in the 26 years (1967-93) that I had been in computers he never was mentioned. I came across him in reading on my own. Then another new employee was installed in my office. This man was from Moscow. I again mentioned Shannon. I was floored by what followed. This man's PhD thesis was proving one of Shannon's unproven theories. To his own delight and amazement (and to mine too) he discovered that Shannon was correct. You can't imagine how awed I was that the Great Spirit had allowed me this personal experience. This young man had never seen a picture of Shannon and I was able to provide him with one. He also gave me a copy of his thesis.

How did Claude Shannon affect your own work?

Since my "meeting" with Shannon happened in my most mature years, it gave me confidence in knowing that there is a single source for ideas. And it works in computers too. It's important to me that the right himan beings be given credit. It also made me sad as I worked with my fellow employees to know they had no concept of such things and so could not revere the computer field the way I did. Above all it gave me pride in being an American.

If you have any other observations or comments, please enter them here.

To think he understood what information really is. What knowledge really is. And it's mathematical. True spirituality for me.

Name

Ethel Jean Saltz

Submitted July 7, 2001, 11:01 AM

How did Claude Shannon affect your own work?

Although I never actually met Claude Shannon, his work greatly influenced my research -- which has drawn heavily on his concepts of information theory and redundancy (in some cases constructively added to achieve error correction and reliable systems out of less reliable subsystems, and in other cases creatively avoided as in compression coding), and cryptography. Reading his papers was true intellectual nourishment, both in graduate school in the 1950s and at Bell Labs in the 1960s. I always remember his example of the predictive coding of the text "There is no reverse on a bicycle" in terms of the expected rank order of the next letter (which began 111511, if I recall correctly). Even my recent efforts in system security, trustworthiness, and survivability draw on his original concepts.

Name

Dr. Peter G. Neumann

Submitted July 7, 2001, 10:49 AM

What are your most vivid memories of Claude Shannon?

I met Claude Shannon at the Awards Banquet of the New York Convention of the Audio Engineering Society (AES) in 1985. I was recognized by the AES with a Fellowship for my contributions to the Compact Disc. Dr. Shannon was the recipient of the AES Gold medal (the Society's highest honor). The very concise citation read (I will never forget this because it is very true): "For contributions that made digital audio possible". It was an unforgettable evening, where at the end of the banquet we could discuss various matters of our interest.

How did Claude Shannon affect your own work?

Channel coding used in the Compact Disc, DVD, and other digital recording products is based on the theoretical work of Shannon. The capacity computations of runlength limited codes such as EFM which is used in the Compact Disc have first been done by Shannon in his 1948 landmark paper.

Name

Kees Immink

Submitted June 6, 2001, 6:37 PM

What are your most vivid memories of Claude Shannon?

Shannon once visited Russia. It was in 1960-ies. Shannon arrived for participation in the Annual Popov Society Conference. About twenty Russian engineers and scientists arrived to the Moscow airport to meet Shannon. We did not see Shannon before and were afraid not to recognize him in flow of incoming passengers. However, when Shannon appeared, it was impossible not to recognize him. Shannon radiated, as it seemed to us, a powerful inherent intellectual light. At the conference, Shannon presented the last results on the bounds to error probability for optimal coding in discrete memoryless channel. The talk was great and raised a long stream of questions and comments. One of the main Russian newspapers "Literaturnaia Gazeta" published an article about Shannon with short interview. When Shannon visited Moscow, he had a meeting with A. N. Kolmogorov in Moscow State University. I was present at that meeting. Shannon told Kolmogorov about some open Information Theory problems. That were the problems on multiuser channels and sources. The problems were new and very interesting. Shannon presented also his intuition on in which Information Theory terms he saw the solutions of these problems. (As we know now, some years after that meeting and independently, T. Cover published his famous paper on one of the multiuser problems. The outstanding results of D. Slepian, J. Wolf, and R. Ahlswede should be mentioned also in this context.) Kolmogorov expressed his extremely

high appreciation of Shannon's work and pointed out the significance of the concepts of entropy and epsilon-entropy not only for the communications science. I had two long-lasting personal conversations with Shannon. The first of them was in Moscow. I accompanied him to the Publishing House Mir, which published the book of Shannon's papers in Russian. Shannon, his wife Mary (as she asked to call her at that time) , and me were on that trip to and from the Publishing House Mir for about one hour. It was interesting for me to learn the Shannon opinion on some unsolved Information Theory problems and some papers, which appeared at that time. My second conversation with Shannon was at MIT (Massachusetts Institute of Technology). Professors P. Elias and R. Gallager invited me in 1969 to work with them for three months at MIT. When I arrived at MIT, I saw an office door with the name "Prof. Claude Shannon". However soon I noticed that Shannon did not come to work at MIT. Professors R. S. Kennedy, H. L. Van Trees, and M. Hellmann told me that Shannon did not appear at MIT at least for a year. I asked to call Shannon and ask him whether he wants to meet me and talk. In spite of a priori skepticism on getting a positive reply such call was done. As a result, Shannon appointed a meeting with me in the MIT Faculty Club Restaurant on lunchtime. One of famous MIT professors suggested accompanying me to the Club. I replied that I could come to the Club without help. I asked that might be the professor had his own interest in accompanying. He answered yes and told me that he wanted to meet Shannon, lift with us in an elevator up to the top floor where the Club was located, and then leave us. During the time in the elevator, he said that he wanted to speak to Shannon about a new problem, which he (the professor) solved recently, and to ask for Shannon's opinion on the problem and the results. The professor said (R. Fano told me the same earlier) that usually, with rare exceptions, the Shannon opinion was that he (Shannon) knew the problem and knew its solution. As it was preplanned, our lifting in the elevator began with the professor talk about his new problem. Just before the stop at the top floor, the professor asked the Shannon opinion. At this time, Shannon said just the same that he was usually saying. During the lunch Shannon writing on the ordinary napkins explained his view on the application of Information Theory to the analysis and prediction of share prices and stock exchange indices. I was very impressed by this presentation. Shannon told me that in the US there was a possibility to get money by playing with shares, whereas in the USSR there was no such possibility. I should say that one month after this meeting with Shannon and after my lecture at IBM, I told B. B. Mandelbrot about Shannon's applications of the information concept and channel capacity to stock exchange processes. B. B. Mandelbrot did not agree with Shannon's approach and said that the stock exchange processes had to be modeled with the help of self-similar processes. Frankly speaking, I do not know up to now which approach is more productive in practice. Also, I remember my brief conversations with Shannon, one on a party given by P. Elias in 1969 and another one on the Information Theory Symposium in June 1985. I am very lucky to be influenced by Shannon who, in my opinion, was a real genius of science.

How did Claude Shannon affect your own work?

Shannon became famous in Russia after his paper "A mathematical theory of communication." In the time of its publication, the Russian authority raised a war against cybernetics naming it as "a false science of obscurantists" (in Russian "lzhenauka mrakobesov"). The paper of Shannon was considered as a part of cybernetics. A nontrivial adroitness was needed to publish its translation in Russian. It was a merit of Professor Zheleznov from Leningrad. The Shannon paper opened a door for numerous research works in Information Theory. The paper itself and the shown-by-it directions for future work became very popular in Russia. They attracted attention not only of communication engineers but also of mathematicians. I think that it was the first time in the history of communication engineering that a remarkable number of mathematicians became involved in the solution of its problems. The outstanding communication engineers A. A. Kharkevich and V. I. Siforov, famous mathematicians A. H. Kolmogorov, I. M. Gelfand, A. M. Yaglom, young scientists M. S. Pinsker, R. R. Varshamov, R. L. Dobrushin, students V. I. Levenshtein, Y. G. Sinai and many others were among the first Shannon followers in Russia at that time. A. A. Kharkevich proposed to elect Shannon to the USSR Academy of Sciences as a foreign member. Unfortunately, the proposal did not find enough support in the Academy. When I finished my first research work and intended to write a paper on it, I had the questions how to construct the paper, how to begin it, how to present the results, and other similar questions. I looked at several papers of the authors famous at that time in order to find a pattern suitable for me. As a result, I chose the paper of Shannon. It had no extra words and sentences. The problem was clearly stated from the beginning. All the concepts and statements were presented without superfluous mathematical symbolic. The relation with other papers was pointed out concretely and essentially. Up to now I keep admiring Shannon's ability to write his papers.

Name

Boris Tsybakov

Submitted May 5, 2001, 3:20 PM

What are your most vivid memories of Claude Shannon?

I never met Shannon. However, some years ago I had decided that he would be intrigued by the progress I had made and sent him some of my papers. I got no response for a while until one day I got a phone call. It was from Betty Shannon, who said that unfortunately Shannon had Altzheimer's and could not respond. At that sad point it was clear that I was on my own...

How did Claude Shannon affect your own work?

Shannon's information theory dramatically affected my work. I entered graduate school looking for a mathematics to describe how living things work. I found out that I could use information theory to dissect what the molecules are doing in living things. Lots more information about this work is given at my web site, http://www.lecb.ncifcrf.gov/~toms/.

If you have any other observations or comments, please enter them here.

My contact info: Dr. Thomas D. Schneider National Cancer Institute Laboratory of Experimental and Computational Biology Frederick, Maryland 21702-1201 toms@ncifcrf.gov permanent email: toms@alum.mit.edu http://www.lecb.ncifcrf.gov/~toms/

Name

Tom Schneider

Submitted April 4, 2001, 2:59 PM

How did Claude Shannon affect your own work?

Claude Shannon and his theory of communication opened up to me an entirely new approach to describing the dynamics of ecosystem behavior. Not that ecosystems fit the scheme of sender-receiver- interpreter that Shannon sketched out, but rather that his formalisms could be so nicely adapted to quantifying the amount of constraint inherent in a network of ecosystem exchanges. I have spent the last 23 years applying Shannon's information theory to ecosystems, and I am still discovering new applications and insights. His work stands for me as a necessary foundation on which I have built my whole career.

Name

Robert E. Ulanowicz

Submitted April 4, 2001, 5:38 PM

What are your most vivid memories of Claude Shannon?

Although I was a student at MIT, I never met Claude Shannon. Nonetheless, his work started my interest in Information Theory that continues to this day.

How did Claude Shannon affect your own work?

Much of my early publications on information theory (1971-1988) relied on Shannon thepory. I shifted to algorithmiccomplexity theory betwen 1988 and 1990, however, because of its conncetions to logic. I now found information theory on logic, and I am developing propositional and predicate calculus within a generalised theory. I consider Shannon's work both brilliant and seminal. Without it, I would not have set off on my own path. On the other, I now consider his work to be a very special (but important) aspect of information theory. Much of my recent work with the Newcastle Complex Organised Adaptive Systems Group is based on information theory.

If you have any other observations or comments, please enter them here.

Readers may be interested in an article of mine on general information theory at http://www.newcastle.edu.au/department/pl/Staff/JohnCollier/information/information.html

Name

John Collier

Submitted March 3, 2001, 12:44 PM

How did Claude Shannon affect your own work?

To pin down a vague but important idea, like energy or infinity or chance, with sufficient precision to make it quantifiable and thus available for rigorous study constitutes a major contribution to civilization. This is what Claude Shannon accomplished with the idea of information. In my own field of ergodic theory, Shannon's information-theoretic entropy has been central since the 1950's. The study of Shannon's channels, sources, automata, and measures of maximal entropy has inspired much work in symbolic dynamics (besides of course information and coding theory and probability). I worked on these matters some time ago with Brian Marcus and Susan Williams, and one of my current research projects (joint with Sujin Shin) is the identification of relatively maximal (Shannon-Parry) measures for factor maps betwen subshifts of finite type (information-compressing channels with restrictions). I find the questions in this area fascinating, because of their approachability, mathematical depth and interest, and potential for applications; I do not expect to run out of them.

Name

Karl Petersen

Submitted March 3, 2001, 11:44 AM

What are your most vivid memories of Claude Shannon?

I believe the year was 1958. Shannon had just returned to MIT from spending a year at Stanford's Institute For Advanced Study in the Behavorial Sciences. He was teaching an advanced seminar on research topics on information theory. I was doing research on the theory of quantization noise. I got to know him, and we had several conversations about research. I was an Assistant Prof of EE at MIT at that time. I had been in contact with John Linvill at Stanford about my joining the faculty there. The decision was made to do this. I told Dr. Shannon that I was going to Stanford to join the faculty in 1959. And he said," Bernie, you are going to God's country. All you need is a great white apron, a chef's hat, and a barbecue, and you'll be all set." (Note: Stanford was pretty quiet then.) At about that time, Dr. Shannon was riding a unicycle. His construction projects were the following, as he described them to me. He had a Volkswagen microbus and he was devising a way to install a shower in it. Thus he was inventing the motorhome. His second project takes some explanation. He described his house as being on a hill overlooking a lake that

was good for swimming during summertime. The problem was to devise a way to get from the house into the lake as fast as possible. He set up pulleys and ropes that he could grab onto and zoom down the hill into the lake. GERONIMO! Can you picture this? I can. I could never forget him.

Name

Bernard Widrow

Submitted March 3, 2001, 5:12 AM

What are your most vivid memories of Claude Shannon?

Computers!

How did Claude Shannon affect your own work?

Shannons contribution to the field of computational physics not only advanced modern computer technology but also provided tools for handling physical problems in many other directions, for instance, in statistical physics, most famous his definition of entropy. This notion of entropy has been used to describe level statistics and localization phenomena in mesoscopics and in quantum chaology. For analogies between mesoscopic physics and quantum chaos see e.g. http://www.mpipks-dresden.mpg.de/mpi-doc/buchleitnergruppe/start.html & http://www.mpipks-dresden.mpg.de/~saw

If you have any other observations or comments, please enter them here.

I really like his book on communication theory.

Name

Sandro Wimberger

Submitted March 3, 2001, 5:57 PM

What are your most vivid memories of Claude Shannon?

Shannon effectively retired around 1965, and so young researchers who entered the field of information theory after that time (including me) never got a chance to meet him until June 1985, when he unexpectedly showed up in Brighton, England, at an International Information theory Symposium. Everyone at the symposium was thrilled to see him, and cameras were clicking all week. At the closing banquet, Shannon was, of course, seated at the head table. About halfway through the banquet Lee Davisson, who was at that time head of the electrical engineering department at the University of Maryland, did what we the rest of us had secretly wanted to do all week: he asked Shannon for his autograph. That opened the floodgates. For the rest of the meal, there was a long line of autograph hounds (including me) waiting for Shannon's autograph. If you know how large scientific egos tens to be, you'll understand how really astonishing this scene was. It was as if Newton had showed up at a physics conference.

How did Claude Shannon affect your own work?

Since I am an information theorist, Shannon gave me my life's work. I first read (parts of) his 1948 paper in 1966, and I reread it every year, with undiminished wonder. I'm sure I get an IQ boost every time. It is no exaggeration to say that Shannon was one of the finest scientific minds of this or any other century, and as a professor I am fortunate in being able to teach Shannon's ideas to new generations of students. The Shannon limits for communication systems will remain as the ultimate goals for communications engineers forever.

Name

Robeert J. McEliece

Submitted March 3, 2001, 4:24 PM

How did Claude Shannon affect your own work?

I never met Claude Shannon, but as a person on the boundary between physics and computer science I can say that his work changed both fields fundamentally. The connection between information and thermodynamic entropy was the first bridge built between computer science and physics --- and contributed historically to others, such as quantum computation and phase transitions in NP-complete problems, which are areas of intense research today. It inspired physicists to see the evolution of physical systems as a form of computation, and gave a mathematical foundation to a seemingly mystical relationship --- the instantiation of information and meaning in a physical form. Manuel Campagnolo, Jose Felix Costa and I have extended Shannon's work on analog computation. He set the stage by showing that his General Purpose Analog Computer (GPAC) is capable of computing exactly the differentially algebraic functions, a beautiful class which is closed under composition and under the process of solving differential equations. By adding various operators to the GPAC, we have obtained analog computation classes closely related to various digital classes from the theory of computational complexity and recursive functions.

If you have any other observations or comments, please enter them here.

Another wonderful contribution of Shannon's was an analog machine for playing the game of Hex, invented by Piet Hein --- in which the board was represented as an electrical network, and the machine places stones at the saddle points of the potential. It performed poorly in the endgame, but did well at the early stages where exhaustive search is impractial.

Name

Cristopher Moore

Submitted March 3, 2001, 11:57 PM

What are your most vivid memories of Claude Shannon?

Unfortunately, I never had the chance to meet him.

How did Claude Shannon affect your own work?

I first encountered Shannon's great 1948 paper in an undergraduate course taught at Cornell by an astronomer, Martin O. Harwit, and was immediately captivated. Indeed, at that time I was not a math major and I credit this encounter with one of the great scientific works of all time as being one of the two major influences which impelled me to change my major and eventually to earn a Ph.D. in mathematics. Even today, after fifty years of tremendous and intensive development, Shannon's paper remains as fresh and intellectually exciting as the day it was written--- in fact, it is so clearly written, so imaginative, and so lively, that even today it remains probably the best short introduction the subject of information theory. This alone is a phenomenon almost without precedent in science (Einstein's papers founding special and general relativity, for example, by 1960 could be clearly seen to have aged not nearly so well). It would be impossible to overestimate the beneficial influence this particular paper has had on my life. I'll briefly describe just one place where it played a truly critical role in my own professional development. In my thesis work on generalized Penrose tilings, I was stuck trying to understand the simplest case, a type of dynamical system called a Sturmian shift. One day I thought of applying Shannon's simple but profound notion of finite type approximations to an information source. This immediately got me "unstuck" and within a few days led almost without effort to my first independent results concerning Sturmian shifts, which later turned out to be among the main theorems in my dissertation (although for lack of time and energy they were only announced there, not really proven). So without Shannon, not only do I doubt I would have -attempted- to earn a Ph.D. in math, but I doubt that would (after a fashion) have succeeded! I truly cannot begin to imagine the course my life would have taken if I had never read (and reread, often) Shannon 1948. This particular notion of Shannon (finite type approximations), which occurs more or less as a motivational remark in his 1948 paper, has continued to greatly influence my subsequent thinking in the field of dynamical systems, and I try to underline its fundamental nature to my colleagues whenever I have the opportunity.

If you have any other observations or comments, please enter them here.

I think his stature, which is already tremendous, can only increase with the passage of time. Even now would not be inappropriate to compare him with such figures as Plato, Aristotle, Newton, Einstein, and Darwin, in terms of his influence on the way we think and live. To briefly recall just three highlights of his career: I doubt whether anyone would dispute the assertion that Shannon's master's thesis was the most important master's thesis ever written. In it, he showed how to perform computations in Boolean propositional logic using electronic switching circuits; I hardly need point out that this development was every bit as fundamental to the development of the digital computer as the more theoretical work of Turing and von Neumann. And it is not at all clear how long this crucial development would have taken if Shannon had not figured it out so early in his career. Without Shannon, it is not clear that the reader would be reading these words, for presumably he or she is doing so using a computer connected to the InterNet--- neither computers nor the InterNet would be possible without the ideas developed in Shannon's remarkable thesis. It is ironic that Shannon's Ph.D. dissertation is less well known today than his master's thesis. In it, he used ideas from what is now called "abstract algebra" (ideas which where then still rather new--- there were hardly any textbooks in any language on this subject yet, despite the fact that the best mathematicians were using these ideas extensively) in a highly original study of genetics. I understand that many years later someone independently rediscovered a similar algebraic model. And of course in his 1948 paper, "A Mathematical Theory of Communication", Shannon founded at one stroke not one but two of the most important, powerful, successful, and still flourishing fields in all of applied mathematics, namely what the subject now called "information theory" (which has elaborated in literally thousands of directions the probabilistic/ergodic theoretic aspects of Shannon's papers) and the subject now called "algebraic coding theory" (which has developed the early ideas of Shannon and Fano on constructing efficient codes which approach the optimal performance which Shannon's great coding theorems guarantee--- after fifty years of continuous development, this goal has finally come significantly closer to being achieved). Information theory in particular is, to my mind, along with linear algebra, the very model of what an ideal mathematical theory is and does. This theory has everything one could possibly ask for: 1. The intuitive meaning of the fundamental quantity of study (entropy) is as clear as such things ever get in mathematics, and this meaning is extremely well motivated (due to Shannon 1948 as well as later work). 2. These entropies are readily -computable- for a huge variety of "information sources" of theoretical or practical interest, and it is always clear what these numbers are telling you when you can compute (or estimate) them. 3. The theory contains a plethora of amazing and beautiful general theorems: Shannon's coding theorems stand out here, but many more have been proven in the fifty years since Shannon founded the field. 4. This theory has been extremely successful at -solving- a variety of tremendously important practical problems, or at least in motivating people to try to do very hard things (find really good codes) which no-one knew, before Shannon, were even -possible-. 5. The theory has been tremendously fruitful--- hundreds if not thousands of individuals, including many of the best mathematicians of the last fifty years, have contributed their own unique insights to provide important new theorems or constructions, and ideas from this theory have been incorporated into a great many other fields in modern mathematics, such as dynamical systems (where various kinds of entropy, including "topological entropy", a notion introduced by Shannon in his 1948 paper under the name of "channel capacity", and closely related quantities such as Lyapounov exponents, are so pervasive they might even be said to dominate the field). In my own work, I have always tried to keep before me the example of Shannon's greatest accomplishment, the theory of information, as something to try, as far as possible, to emulate, in its generality, clarity, focus, power, and intellectual beauty.

Name

Chris Hillman

Submitted March 3, 2001, 11:01 AM

What are your most vivid memories of Claude Shannon?

When I met him and his lovely wife during the Brighton ISIT Symoposium in 1985. He was very timid and enjoyed our admiration. He was juggling with 3 balls during the banquet in order to entertain us. His wife escorted him around and looked after him with love.

How did Claude Shannon affect your own work?

Not very much until the Turbo codes were discovered. Not because his work was not good, but because the practical codes were very far from those which could be implemented. Then after the discovery of the turbo codes, the performance her predicted all by a suddent became practical bounds, only a few tenth of a dB from practical implemented codes.

If you have any other observations or comments, please enter them here.

I attach a picture of Claude, Tor Aulin and myself taken in Brighton 1985, by email.

Name

Torleiv Maseng

Submitted March 3, 2001, 8:33 AM

What are your most vivid memories of Claude Shannon?

Shannon will be remembered for his profound insight; for his ability to strike at the very heart of a complicated problem in a clear and uncomplicated way. Although I never met him, I, along with all researchers in coding and information theory, have been affected greatly by his work. I have always been attracted to Shannon's work, both because of the clean elegance of the central ideas, and by the fact that these ideas have so much to say about actual practice. In my experience, designers of communication systems who ignore the wisdom of Shannon do so at their peril, for those well-versed in Shannon's work will often be able to design communication systems that work better.

Name

Frank Kschischang

Submitted March 3, 2001, 8:48 PM

What are your most vivid memories of Claude Shannon?

The only time I met Claude was at the IEEE International Symposium on Information Theory at Ann Arbor, Michigan, in October 1986. After an absence of many years (since 1973, in fact, when he delivered the first Shannon Lecture in Ashkelon, Israel) from attending our Symposia, Claude showed up unannounced at our 1985 Symposium in Brighton, England. Most of us, including myself, didn't even know who he was. But there was a buzz going the Symposium: "Shannon's here. Where, where? Well, I saw him on the elevator about an hour ago." Anyway, I never met him at Brighton, but as President of the Society in 1986, we decided to invite him to formally participate. He and Betty both came and enjoyed themselves immensely. His Alzheimer's had already begun by that time, and we asked Betty if it was okay for Claude to make a few remarks at our banquet. She said she thought he would be fine. As things turned out, he was more than fine, wowing the audience with a roughly 15 minute talk laced with interesting anecdotes and delightful humor. It was a joy to behold.

How did Claude Shannon affect your own work?

I work in the area of channel coding. I always tell my students that Shannon had the foresight to prove the EXISTENCE of good codes in his 1948 paper, but not to tell us how to find them. Thus he provided myself and many other researchers around the world with gainful employment over the last 50+ years searching for good codes and efficient methods of decoding them! What more could we ask from a mentor?

Name

Daniel Joseph Costello Jr.

Submitted March 3, 2001, 8:52 PM

What are your most vivid memories of Claude Shannon?

I had no direct exposure to Shannon.

How did Claude Shannon affect your own work?

I was very much impacted by his work in that he set the bounds and the basic methods that we eventually used to reach near-capacity transmission levels in DSL. Being fascinated by the work as a young graduate student, I actually named my dog, a golden retriever who was my companion and best friend for 16 years, Shannon. I have pursued the achievement of Shannon's bounds in all my work for the past 20 years. Shannon's work was indeed the most influential in the area of DSL, and indeed some kind of concept of DSL is what probably what his original motivating application for the theory of mathematical communication, making phone lines play at the maximum possible data rates. It was an ironic shame that his company Bell Laboratories opposed the use of those techniques right up to the end (and actually Intel's Chairman made a personal request to Bell Labs Chairman to stop blocking international standardization of DSL using methods basically outlined by Shannon in the original paper), and even today Lucent Bell Labs oppose his methods' use in a few areas (although AT&T's Research Lab -- sometimes called Shannon labs -- and Bell Communications Research have supported their use for many years).

Name

John M. Cioffi

Submitted March 3, 2001, 4:05 PM

What are your most vivid memories of Claude Shannon?

I got in touch with information theory in my PhD, in 1983 and I immediately loved this area, especially channel coding. My doctor father often told about Claude Shannon when he met him at conferences. I remember the conference where Shannon was juggling.

How did Claude Shannon affect your own work?

Since I am working in information theory I know and like all the work of Shannon. It is amazing how clear and beautiful his papers are.

If you have any other observations or comments, please enter them here.

Unfortunately more people know Einstein than Shannon even if the work of Einstein did not influence the "every day life" of people so sustainably than Shannons work.

Name

Martin Bossert

Submitted August 8, 2001, 10:45 AM

How did Claude Shannon affect your own work?

My professors at Berkeley were both students of Claude Shannon. David Sakrison and George Turin were responsible for the graduate program in communications theory. As a Masters student, I went though the program, and was able to successfully navigate the courses, and perform much better than I had originally expected. I had one problem: I just didn't really grasp the basics. Everyone was so busy instructing, teaching, writing new books, and I had somehow missed something important. One day in George Turin's office, I mentioned that I just didn't get it. He was obviously hurt, but then asked if I had read the original papers by Shannon. I had not. He handed me his personal copy of the orginal three papers that he had used while a student at MIT. In 15 minutes, there in his office, I read, and finally understood what it was all about. The elegance, and beauty of the field of communications theory was suddenly clear. When finished, I was shaking. I never met the man, but I have the utmost respect and admiration for anyone who can communicate so clearly in a technical paper. As a standard, I hope all professors strive to achieve what Claude Shannon was able to achieve. I refer to myself as "third generation Shannon" as I now take the legacy on, and pass out copies of the three papers, rather that attempt to place my own academic mark on them.

Name

Austin Lesea

Submitted August 8, 2001, 9:30 AM

How did Claude Shannon affect your own work?

He inspired my web site: http://www.jtan.com/guess/

Name

Chris Nadovich

Submitted March 3, 2001, 6:29 PM

What are your most vivid memories of Claude Shannon?

Shannon's foundational work on information theory is one of the greatest scientific accomplishments of the last century. In addition to this work, Shannon made pioneering contributions to computer architecture, cryptography, and artificial intelligence. His Master's thesis demonstrates that it is possible to build circuits that perform Boolean algebra in order to carry out calculations. This computing calculus is fundamental to the operation of modern computers. Shannon's 1949 paper on cryptography transformed the field from an art to a science. Shannon also built the first chess-playing machine and the first maze-solving mechanical mouse, thus helping to create the discipline of artificial intelligence. I never knew Shannon personally, but my thesis advisor in graduate school was one of the few people to collaborate with Shannon. Shannon had a tremendous influence on the way my advisor and his peers looked at science and

engineering problems. This influence has now propagated to another generation of students. Thousands of people have been inspired by Shannon's writings and his fame was of legendary proportions.

How did Claude Shannon affect your own work?

I am a Member of Technical Staff in the Computing Principles Research department, which is a part of the Computing Sciences Research center at Bell Labs. The first problem that Shannon addressed in his landmark 1948 paper on information theory was the ultimate compression achievable on discrete data. My own research has primarily focused on the design and analysis of data compression algorithms. Though people have been studying and creating compression algorithms for over fifty years, compression is continually gaining importance because the information revolution has produced a society that creates, transmits, and stores vast amounts of data. Compression is so significant a research area that since 1991, the Institute for Electrical and Electronics Engineers (IEEE) has sponsored an annual conference devoted exclusively to data compression.

If you have any other observations or comments, please enter them here.

Claude Elwood Shannon American Mathematician and Electrical Engineer ---------- Shannon was born in Petoskey, Michigan, on April 30, 1916.He graduated from the University of Michigan in 1936 with bachelor's degrees in mathematics and electrical engineering. In 1940 he earned both a master's degree in electrical engineering and a Ph.D. in mathematics from the Massachusetts Institute of Technology (MIT). Shannon joined the mathematics department at Bell Labs in 1941 and remained affiliated with the Labs until 1972. He became a visiting professor at MIT in 1956, a permanent member of the faculty in 1958, and a professor emeritus in 1978. In 1948 Shannon published his landmark "A Mathematical Theory of Communication." He begins this pioneering paper on information theory 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 then proceeds to so thoroughly establish the foundations of information theory that his framework and terminology remain standard. Shannon's theory was an immediate success with communications engineers and stimulated the technology which led to today's Information Age. Shannon published many more provocative and influential articles in a variety of disciplines. His master's thesis, "A Symbolic Analysis of Relay and Switching Circuits," used Boolean algebra to establish the theoretical underpinnings of digital circuits. This work has broad significance because digital circuits are fundamental to the operation of modern computers and telecommunications systems. Another example is Shannon's 1949 paper entitled "Communication Theory of Secrecy Systems." This work is now generally credited with transforming cryptography from an art to a science. Shannon was renowned for his eclectic interests and capabilities. A favorite story describes him juggling while riding a unicycle down the halls of Bell Labs. He designed and built chess-playing, maze-solving, juggling and mind-reading machines. These activities bear out Shannon's claim that he was more motivated by curiosity than usefulness. In his words "I just wondered how things were put together."

Name

Serap Savari

Submitted March 3, 2001, 5:14 PM

What are your most vivid memories of Claude Shannon?

His 1948 paper. In one stroke, this paper laid down the foundations of digital communication. Seldom a field is started by one paper. This one did.

How did Claude Shannon affect your own work?

I am most influenced by his "simple model" approach to solving difficult engineering problems: take a complex problem, strip it down to its essentials, formulate a simple model to capture the essence, and ask the right questions. The answers in turn provide deep insights for the original problem. Communication researchers are still following the path he showed us.

Name

David Tse
