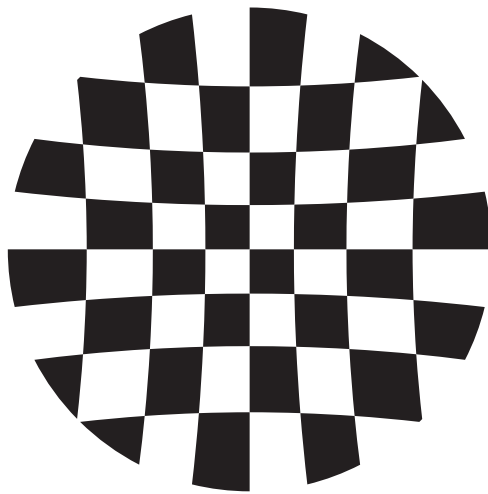


# Biographies in Data Compression



History is the essence of innumerable biographies  
—Thomas Carlyle (1795–1881)

## Preface

A biography is a description of someone's life, usually published in the form of a book or essay, or in some other form, such as a film. An autobiography is a biography written by its subject. A biography is more than a list of impersonal facts (education, work, relationships and death), it also portrays the subject's experience of those events. Unlike a profile or curriculum vitae, a biography presents the subject's story, highlighting various aspects of his or her life, including intimate details of experiences, and may include an analysis of the subject's personality. (From Wikipedia).

This free Ebook is intended to be a collection of biographies of people who have contributed to the growing field of data compression. This field, like most of computer science, is young and most of the participants are still around, thereby making it easy to obtain biographical material. Anyone active in the field have heard the names of many contributors and might be interested in knowing something about their backgrounds, education, interests, and lives in general.

Much is known about scientists in other fields. Eric Weisstein's World of Biography (<http://scienceworld.wolfram.com/biography/topics/BranchofScience.html>) lists 257 biographies of mathematicians, 299 biographies of physicists, and 147 biographies of astronomers (among many others), but not a single biography of a computer scientist.

Thus, this book is being put together in an attempt to correct this situation. In March 2009, the following message was sent to many people active in data compression:

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Dear Sir/Madam,

You are invited to participate in the "Biographies in Data Compression" project. The idea is to have a free Ebook with biographies of people active in the vast, fascinating field of data compression. Anyone even remotely associated with data compression may have heard the names Huffman, Ziv, Lempel, Elias, Shannon, Fano, Rice, and others. Who are (were?) those people? What backgrounds did they come from? What were their principal achievements? What did they look like? If you have ever asked such questions, why not join this project? All it takes is for you to submit your biography to the address below and wait for the next edition of this free Ebook.

The first edition (edition 0) of the book is ready for your download and perusal at "<http://www.davidsalomon.name/>." It contains only a few biographies, mostly of deceased persons, and some of people who contributed only indirectly.

There are no special rules or restrictions. Your submission can be as short or as long as you want. It is only recommended to include the following: Full name, affiliation, email, year of birth, (if you write for someone deceased, also year of death), education, professional experience, principal contributions to data compression, main publications in this field, and a portrait (preferably in color).

If you consider this idea worthwhile, please forward this message to your friends, colleagues, and anyone you know in data compression. If you are qualified to write a biography of a deceased person, I encourage you to do so.

Submissions should be sent in plain text to "dsalomon@csun.edu" with the pictures in any image format. Contributions will be added to the book as they arrive. Any questions, corrections, and comments should also be directed to the address above.

With thanks for your cooperation and interest,

History is the essence of innumerable biographies, (Thomas Carlyle, 1795–1881)

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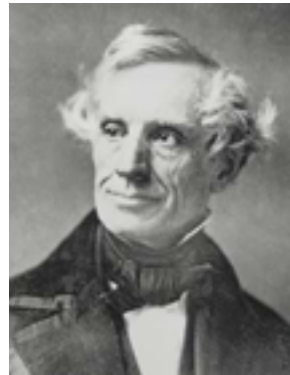
If this book is successful, it might be the first in a series of books about computer scientists, but its success depends on the cooperation of many individuals. Let's hope for the best.

David Salomon

March, 2009

### Samuel Morse

Samuel Finley Breese Morse (1791–1872) is well known as the creator of the modern telegraph and the code that bears his name. Few know that he was a painter (of portraits and historic scenes) for most of his life. He was born on April 27, 1791 in Charlestown, Mass. His father was a great preacher of the Calvinist faith and supporter of the American Federalist party. As such, the father strongly believed in education and sent his first-born son to the Phillips Academy in Andover, Mass., and from there to Yale College. While at Yale, Morse attended lectures on electricity which, as we now know, came in handy later. He earned money by painting.



After a long, unsuccessful career as a portrait painter, Morse turned to inventing to make his fortune. With his previous training in electricity he realized that pulses of electrical current could convey information over wires.

His interest in telegraphy began in 1832, and the elements of a relay system were worked out late in 1835. The equipment was gradually improved and was demonstrated in 1837. To support himself later in life Morse was largely dependent on dividends from telegraph companies. In 1858 several European countries combined to pay a gratuity of 400,000 francs as compensation for their use of his system.

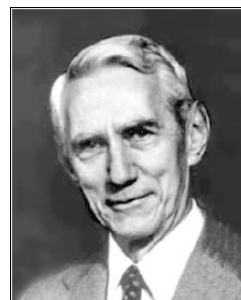
Contributions to data compression (indirect): The Morse code, which is one of the first variable-length codes.

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### Claude Shannon

Information theory is the creation, in the late 1940s, of Claude Elwood Shannon (1916–2001). Shannon was born in Petoskey, Michigan. The first sixteen years of his life were spent in Gaylord, Michigan, where he attended public school. Shannon showed an inclination towards mechanical things. While growing up, he worked as a messenger for Western Union. His childhood hero was Thomas Edison. In 1932 Shannon entered the University of Michigan, where he took a course that introduced him to the works of George Boole. He graduated with two bachelor's degrees, in electrical engineering and in mathematics, then began graduate study at MIT, where he worked on Vannevar Bush's differential analyzer.



While studying the complicated ad hoc circuits of the differential analyzer, Shannon saw that Boole's concepts could be used to great utility. In his thesis, Shannon proved that Boolean algebra and binary arithmetic could be used to simplify the arrangement of the electromechanical relays then used in telephone routing switches, then turned the

concept upside down and also proved that it should be possible to use arrangements of relays to solve Boolean algebra problems.

During World War II, Shannon joined Bell Labs to work on fire-control systems and cryptography. He met his wife Betty when she was a numerical analyst at Bell Labs.

In 1948 Shannon published his important paper *A Mathematical Theory of Communication*, a work that focuses on the problem of how best to encode the information a sender wants to transmit. In this fundamental work he used tools in probability theory, developed by Norbert Wiener, which were in their nascent stages of being applied to communication theory at that time. Shannon developed information entropy as a measure for the uncertainty in a message while essentially inventing the field of information theory.

Contributions to data compression: Created information theory.

C. E. Shannon “A mathematical theory of communication,” *Bell System Technical Journal*, **27**:379–423 and 623–656, July and October, 1948.

### Peter Elias

Peter Elias (1923–2001) was a pioneer in the field of information theory. Born in New Brunswick, NJ, he attended Swarthmore College for two years before transferring to MIT in 1942. In 1944, he enlisted in the United States Navy and served as a radio technician instructor. After he was discharged in 1946 with the rank of Electronic Technician’s Mate first class, he earned an M.A., a M.Eng and Sci., and a Ph.D. from Harvard University. Elias was a member of MIT faculty from 1953 to 1991. In 1955, Elias introduced convolutional codes as an alternative to block codes. He also established the binary erasure channel. In addition to being a member of the MIT faculty, Professor Elias held visiting professorships at the University of California/Berkeley in 1967-68, the Imperial College of Science and Technology in London in 1975-76, and at Harvard in 1983-84.

He died at 78 of Creutzfeldt-Jakob disease.

Contributions to data compression: His gamma, delta, and omega variable-length codes.

Elias, P. (1975) “Universal Codeword Sets and Representations of the Integers,” *IEEE Transactions on Information Theory*, **IT-21**(2):194–203, March.



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### Vladimir Levenshtein

Vladimir Iosifovich Levenshtein (born 1935) is a Russian scientist who did research in information theory and error-correcting codes. Among other contributions, he is known for the Levenshtein distance algorithm, which he developed in 1965. Levenshtein graduated from the Department of Mathematics and Mechanics of Moscow State University in 1958 and has worked at the Keldysh Institute of Applied Mathematics in Moscow ever since. He is a fellow of the IEEE Information Theory Society, and a recipient of the 2006 Richard W. Hamming Medal (for “For contributions to the theory of error-correcting codes and information theory, including the Levenshtein distance”).



Dr. Levenshtein has provided the best-known universal bounds to optimal sizes of codes and designs in metric spaces, including the Hamming space and the Euclidean sphere. In particular, they led to the discovery of the long-sought kissing numbers for  $n=8$  and  $n=24$ . Dr. Levenshtein authored optimal constructions for several error correcting problems, including: codes that correct a quarter or more of the errors present; codes with a given comma free index; perfect codes able to correct single deletions and single peak shifts; and binary codes with a given probability of undetected error. His work on the universal efficient coding of integers has led to algorithms that offer promising applications in data compression.

Contributions to data compression: The Levenstein variable-length code.

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### Christian Goldbach

Christian Goldbach was a Prussian mathematician. Born in 1690, the son of a pastor, in Königsberg (East Prussia), Goldbach studied law and mathematics. He traveled widely throughout Europe and met with many well-known mathematicians, such as Gottfried Leibniz, Leonhard Euler, and Nicholas (I) Bernoulli. He went to work at the newly opened St Petersburg Academy of Sciences and became tutor to the later Tsar Peter II. The following quotation, from [Mahoney 90] reflects the feelings of his superiors in Russia “...a superb command of Latin style and equal fluency in German and French. Goldbach’s polished manners and cosmopolitan circle of friends and acquaintances assured his success in an elite society struggling to emulate its western neighbors.”

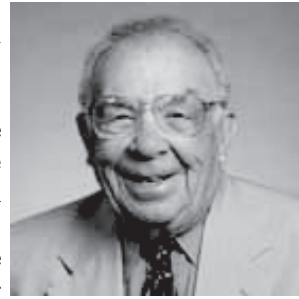


Goldbach is remembered today for Goldbach’s conjecture. He also studied and proved some theorems on perfect powers. He died in 1764.

Contributions to data compression (indirect): The various Goldbach variable-length codes.

**Robert Fano**

Robert Mario Fano (b. 1917)] was Ford Professor of Engineering, in the Department of Electrical Engineering and Computer Science at the Massachusetts Institute of Technology until his retirement. In 1963 he organized MIT's Project MAC (now the Computer Science and Artificial Intelligence Laboratory) and was its Director until September 1968. He also served as Associate Head of the Department of Electrical Engineering and Computer Science from 1971 to 1974.



Professor Fano chaired the Centennial Study Committee of the Department of Electrical Engineering and Computer Science whose report, "Lifelong Cooperative Education," was published in October, 1982.

Professor Fano was born in Torino, Italy, and did most of his undergraduate work at the School of Engineering of Torino before coming to the United States in 1939. He received the Bachelor of Science degree in 1941 and the Doctor of Science degree in 1947, both in Electrical Engineering from MIT. He has been a member of the MIT staff since 1941 and a member of its faculty since 1947.

During World War II, Professor Fano was on the staff of the MIT Radiation Laboratory, working on microwave components and filters. He was also group leader of the Radar Techniques Group of Lincoln Laboratory from 1950 to 1953. He has worked and published at various times in the fields of network theory, microwaves, electromagnetism, information theory, computers and engineering education. He is author of the book entitled "Transmission of Information," and co-author of "Electromagnetic Fields, Energy and Forces" and "Electromagnetic Energy Transmission and Radiation." He is also co-author of Volume 9 of the Radiation Laboratory Series.

Contributions to data compression: The Shannon-Fano algorithm.

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## David Huffman

Being originally from Ohio, it is no wonder that Huffman went to Ohio State University for his BS (in electrical engineering). What is unusual was his age (18) when he earned it in 1944. After serving in the United States Navy, he went back to Ohio State for an MS degree (1949) and then to MIT, for a PhD (1953, electrical engineering).



That same year, Huffman joined the faculty at MIT. In 1967, he made his only career move when he went to the University of California, Santa Cruz as the founding faculty member of the Computer Science Department. During his long tenure at UCSC, Huffman played a major role in the development of the department (he served as chair from 1970 to 1973) and he is known for his motto “my products are my students.” Even after his retirement, in 1994, he remained active in the department, teaching information theory and signal analysis courses.

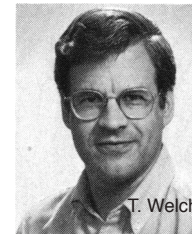
Huffman made significant contributions in several areas, mostly information theory and coding, signal designs for radar and communications, and design procedures for asynchronous logical circuits. Of special interest is the well-known Huffman algorithm for constructing a set of optimal prefix codes for data with known frequencies of occurrence. At a certain point he became interested in the mathematical properties of “zero curvature” surfaces, and developed this interest into techniques for folding paper into unusual sculptured shapes (the so-called computational origami).

Contributions to data compression: The all-important Huffman codes.

Huffman, David (1952) “A Method for the Construction of Minimum Redundancy Codes,” *Proceedings of the IRE*, **40**(9):1098–1101.

## Terry welch

Virtually nothing is known about Terry Welch, of LZW fame. He passed away in 1985 and the following is taken from his chief 1985 paper in *IEEE Computer*. Anyone with more information is invited to contribute. Terry A. Welch is a senior manager for Digital Equipment Corporation, now on assignment in Austin, Texas, as DEC liaison to MCC’s advanced computer architecture program. Prior to joining DEC in 1983, he was manager of computer architecture research at the Sperry Research Center, Sudbury, Massachusetts, for seven years.



Previously he taught at the University of Texas at Austin and worked in computer design at Honeywell in Waltham, Massachusetts. His BS, MS, and PhD degrees were received from MIT in electrical engineering. Welch is a senior member of IEEE and is active in various IEEE-CS activities.

Contributions to data compression: The popular LZW algorithm.



Welch, T. A. (1984) “A Technique for High-Performance Data Compression,” *IEEE Computer*, **17**(6):8–19, June.

### Philip Katz

Phillip W. Katz was born in 1962. He received a bachelor’s degree in computer science from the University of Wisconsin at Madison. Always interested in writing software, he started working in 1984 as a programmer for Allen-Bradley Co. developing programmable logic controllers for the industrial automation industry. He later worked for Graysoft, another software company, in Milwaukee, Wisconsin. At about that time he became interested in data compression and founded PKWare in 1987 to develop, implement, and market software products such as PKarc and PKzip. For a while, the company was very successful selling the programs as shareware.



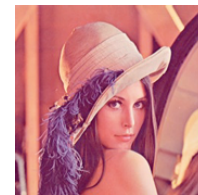
Always a loner, Katz suffered from personal and legal problems, started drinking heavily, and died on April 14, 2000 from complications related to chronic alcoholism. He was 37 years old.

After his death, PKWare was sold, in March 2001, to a group of investors. They changed its management and the focus of its business. PKWare currently targets the corporate market, and emphasizes compression combined with encryption. Their product line runs on a wide variety of platforms.

Contributions to data compression: The PKZIP algorithm and software.

### Lena Soderberg

Lena Soderberg (b. 1951 in Sweden; the actual Swedish spelling of this name is Lena Söderberg, but she is better known without the diacritics) appeared as a Playmate in the November 1972 issue of *Playboy* magazine, under the name Lenna Sjööblom. Her centerfold was photographed by Dwight Hooker. Her photo (known as Lenna) is often used in the field of digital image processing. She was a guest at the 50th annual Conference of the Society for Imaging Science and Technology in 1997 where she was busy signing autographs, posing for pictures, and giving a presentation about herself. The Anglicized version “Lenna” of her name comes from the *Playboy* article; *Playboy* changed the original “Lena.” The picture’s history was described in the May 2001 newsletter of the IEEE Professional Communication Society, in an article by Jamie Hutchinson:



“Alexander Sawchuk estimates that it was in June or July of 1973 when he, then an assistant professor of electrical engineering at the University of Southern California Signal and Image Processing Institute (SIPI), along with a graduate student and the

SIPI lab manager, was hurriedly searching the lab for a good image to scan for a colleague's conference paper. They got tired of their stock of usual test images, dull stuff dating back to television standards work in the early 1960s. They wanted something glossy to ensure good output dynamic range, and they wanted a human face. Just then, somebody happened to walk in with a recent issue of Playboy."

Contributions to data compression (indirect): Her image.

### Alfred Haar

Alfréd Haar was born in Budapest and received his higher mathematical training in Göttingen, where he later became a privatdozent. In 1912, he returned to Hungary and became a professor of mathematics first in Kolozsvár and then in Szeged, where he and his colleagues created a major mathematical center.

Haar is best remembered for his work on analysis on groups. In 1932 he introduced an invariant measure on locally compact groups, now called the Haar measure, which allows an analog of Lebesgue integrals to be defined on locally compact topological groups. Mathematical lore has it that John von Neumann tried to discourage Haar in this work because he felt certain that no such measure could exist. The following limerick celebrates Haar's achievement.



Contributions to data compression: The Haar transform.

Said a mathematician named Haar,  
 "Von Neumann can't see very far.  
 He missed a great treasure—  
 They call it Haar measure—  
 Poor Johnny's just not up to par."

### Raymond Dolby

Dolby Laboratories was founded by Ray Dolby (b. 1933), who started his career in high school, when he went to work part-time for Ampex Corporation in Redwood City, California. While still in college, he joined the small team of Ampex engineers dedicated to inventing the world's first practical video tape recorder, which was introduced in 1956; his focus was the electronics.

Upon graduation from Stanford University in 1957, Dolby was awarded a Marshall Fellowship to Cambridge University in England. After six years at Cambridge leading to a Ph.D. in physics, Dolby worked in India for two years as a United Nations Adviser to the Central Scientific Instruments Organization. He returned to England in 1965 to found his own



company, Dolby Laboratories, Inc. in London. Always a United States corporation, the company moved its headquarters to San Francisco in 1976.

Contributions to data compression (indirect): The AC-3 audio compression algorithm and implementation.

### Raymond Lau

Born in 1971 in New York, Ray Lau spent the majority of his early years there and moved to Boston, Mass. at the start of college in 1989. Ray has remained there since and presently resides along the Boston Harbor waterfront in the historic Charlestown Navy Yard.

Raymond obtained all three of his degrees (S.B., S.M., Ph.D.) from MIT. To learn more about his academic credentials, please visit his website <http://www.raylau.com/>. Professionally, he is known for numerous entrepreneurial achievements in the technology area including iPhrase (sold to IBM), Handango and StuffIt (now part of Smith Micro). He has received numerous awards including the MacUser Derek Van Alstyne Rising Star award (1989), the MacUser UK Lifetime Achievement award (1995), the TransPacific Top 40 Asian American Professionals distinction (1996), and Technology Review's TR100: Innovators Under 35 Who Will Create the Future (2002). Please see the website for more details.



Contributions to data compression: The Stuffit compression software for the Macintosh.

Quote from his High school yearbook, 1989 "All I want is a little more than I will ever get..."

### Renato Capocelli

Renato Capocelli (1940–1992), chairman of the Computer Science Department of the University of Rome "La Sapienza" and IEEE Fellow, died in April in Rome Italy at the age of 52. His death came as a great shock to all who knew him.

Renato established himself in the field of information theory. He published 76 papers about various kinds of codes, entropy series, text compression, semigroups, communication over noisy channels and Fibonacci search. Renato contributed significantly to the building of Computer Science in Italy. For eight years he chaired the Department of Computer Science of the University of Salerno, turning it into one of the best in Italy. He recently moved to Rome, where he founded and chaired the Computer Science department.



Many of us are indebted to Renato for organizing international conferences. Renato loved his home in the Campania region and contrived to have those meetings in the gulf of Naples where he infected one and all with his love for his native region, its food, wine and songs. Sequences89 and Sequences91 were held in Positano Italy. They served as excellent forum for fruitful exchanges of ideas among scientists from many mathematical disciplines. See Mike Luby's report on Sequences89 in SIGACT News 20,1 (Winter 1989), pp. 40–42 and Jim Storer's report on Sequences91 in SIGACT News 22,4 (Fall 1991), pp. 20–22.

Renato had planned to organize Sequences93. We hope to go on and hold it next year in his memory. We send condolences to his wife Rita and his two children Maria-Vittoria and Salvatore.

The text above is by Zvi Galil, *ACM SIGACT News*, **23**(2):104, Spring 1992.

Contributions to data compression: Many contributions to information theory.

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### David John Wheeler

David J. Wheeler (1927–2004) is known to the reader as a codeveloper of the Burrows-wheeler transform, but this was only one of his many distinctions. He was a pioneer in the field of computing whose achievements include developing the assembly language (with Maurice Wilkes) for the Edsac computer at Cambridge, England and software for the Illiac-IV computer at the University of Illinois, as well as inventing the important programming tool known as the closed subroutine.

In collaboration with Maurice Wilkes and Stanley Gil, Wheeler published, in 1951, the first book for programmers *The Preparation of Programs for an Electronic Digital Computer*. In the same year he received the first doctorate in computer science awarded by Cambridge.

He then became an assistant professor at the University of Illinois, where he worked on developing system software for the Illiac and other computers.

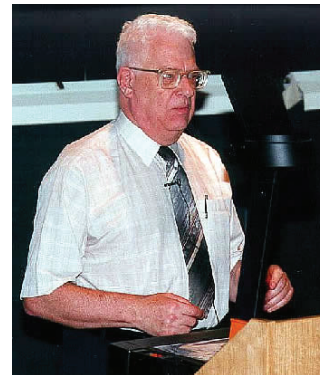
Two years later, in 1953, he returned to Cambridge and assumed a key role in developing the assembly language of the Edsac 2 computer, a project that lasted until 1958.

In 1957 Wheeler married Joyce Blackler, a research student in applied mathematics at Cambridge.

Wheeler officially retired in 1994 but remained active at Cambridge until his death. He made important contributions to computer networks, data compression, and encryption.

In 1981 he became an FRS (Fellow of the Royal Society) and in 1985 he received from the IEEE the Pioneer Medal “for assembly language programming.”

See [http://www.thocp.net/biographies/wheeler\\_david.htm](http://www.thocp.net/biographies/wheeler_david.htm) for more details.



Contributions to data compression: The Burrows-wheeler transform.

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### Shimon Even

Shimon Even was born in Israel on June 15th, 1935. He died on May 1st, 2004. In addition to his pioneering research contributions (most notably to Graph Algorithms and Cryptography), Shimon is known for having been a highly influential educator. He played a major role in establishing computer science education in Israel (e.g., at the Weizmann Institute and the Technion). He served as a source of professional inspiration and as a role model for generations of young students and researchers. Two notable avenues of influence were his PhD students and his books *Algorithmic Combinatorics* (Macmillan, 1973) and *Graph Algorithms* (Computer Science Press, 1979).



From [http://www.wisdom.weizmann.ac.il/~oded/s\\_even.html](http://www.wisdom.weizmann.ac.il/~oded/s_even.html).

Contributions to data compression: The Even–Rodeh variable-length codes.

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Take three hundred men out of history and  
we should still be living in the stone age.

Arthur Keith (1866–1955)

