Obituary

Gus Solomon, 1930–1996.

by Bob McEliece

Gustave Solomon, world-renowned coding theorist, legendary character, and beloved friend and teacher to many members of the Information Theory Society, died at his home in Beverly Hills, California, on January 31, 1996. He was 65

Born in New York City on October 27, 1930, Solomon received a B.A. from Yeshiva University 1951, and a Ph.D. from MIT in 1956, both degrees in mathematics. He began his career in academia, but most of it was spent in research laboratories, including MIT Lincoln Laboratories (1957–1961), the Jet Propulsion Laboratory (1961–1967), TRW Systems (1967–1976), and the Hughes Aircraft Co. (1978–1989). He consulted regularly at the Jet Propulsion Laboratory after his retirement from Hughes.

Solomon was one of the founders of the algebraic theory of error-correcting codes, and he had a long and fruitful career in coding, beginning in 1957 and continuing until the time of his death. His most significant coding contribution was his invention in 1960, with Irving Reed, of the Reed-Solomon codes, which protect the integrity of digital information in modern communication and data storage systems, including the Voyager and Galileo spacecraft, the compact disk, digital audio tapes, and HDTV. Indeed, in 1995 Solomon and Reed were co-recipients of the IEEE Masaru Ibaka Consumer Electronics Award with the citation "For contributions to basic error correcting codes, specifically the Reed-Solomon Codes, which have led to the compaction of data and made possible a generation of consumer compact optical disk products."

But Gus also authored or co-authored dozens of other influential articles on coding, including papers that introduced the Mattson-Solomon polynomial, the Solomon-Stiffler construction of optimal punctured codes, the Solomon-McEliece weight formula, the "tail-biting" construction of block from convolutional codes, and some of the earliest work on constructing sets of sequences with low-cross-correlation properties for spread-spectrum applications. At the time of his death, he had just completed an article on "Subspace Subcodes of Reed-Solomon codes," co-authored with Masayuki Hattori and Bob McEliece. A complete list of his publications follows this article.

Gus's interests and abilities extended far beyond the borders of information theory. Music, in particular, was a second career for him. Coming from a family of singers, he was an accomplished singer himself, and sang chorus tenor in many of the classical oratorios and requiems as well as small operatic parts in Boston and Los Angeles. Gus studied piano and began composing songs while still in his teens, and he leaves behind a collection of over 40 popular and folk songs. In collaboration with Michel Evje, Gus produced a unique set of "Do It Yourself" recordings of Handel's Messiah, whose goal was to facilitate the study of the choral parts. On

one stereo channel was a recording of a single voice and on the other a recording of the ensemble. By switching between the two channels singers could learn and practice their parts. This elegant and unique use of technology for education was a typical example of Gus's inventiveness.

He began teaching voice in 1961, in many cases to the "terminally tone deaf," as he called them, and achieved instant success with no remissions in almost all cases. In 1995 he served as voice coach to the cast of a professional Los Angeles production of Shakespeare's *Henry IV*. In the 1970's he became deeply interested in body/mind exploration and studied movement under Moshe Feldenkreis, Sc.D., the inventor of the Feldenkreis Method of neurological retraining. Gus was certified in 1983 by Feldenkreis to teach his method, which he then extended to include singing and speech. He then became a voice and movement teacher to hundreds of students, including many professional actors and actresses. In 1995 he wrote a book entitled "Breathing in Three Dimensions," a self-help book elaborating his methods and techniques, and using the popular three-dimensional stereograms as an aid to relaxation.

Although he never held a permanent position as a university professor, he was a gifted and beloved teacher, and had a special interest in helping young people, whom he delighted with his idiosyncratic and wildly funny yet deeply insightful view of the world.[1] Many of his proteges went on to distinguished careers of their own in academia or industry, and he will be remembered fondly by the many people he mentored in mathematics, engineering, acting, voice, and movement.

He is survived by a daughter, Grace Solomon Cheifetz, and by two brothers, Alex and Julius, and their families.

[1]Some of Gus's friends are collecting anecdotes about him, for possible publication. Please send your contributions to me at rjm@systems.caltech.edu.

Publications of Gustave Solomon

Technical Publications:

- (with I. S. Reed) "Polynomial Codes Over Certain Finite Fields," *J. Soc. Indus. Appl. Math,* vol. 8, no. 2, pp. 300–304, 1960.
- "A Note on a New Class of Codes," *Information and Control,* vol. 4, no. 4, pp. 364–370, 1961.
- (with H. F. Mattson) "A New Treatment of Bose-Chaudhuri Codes," *J. SIAM,* vol. 9, no. 4, pp. 654–669, 1961.
- "A Weight Formula for Group Codes," *IEEE Trans. Inform. Theory,* vol. IT-8, pp. S1-S4, 1962.
- (with J. J. Stiffler) "Algebraically Punctured Cyclic Codes," *Information and Control,* vol. 8, no. 4, pp. 170–179, April 1965.
- (with R. McEliece) "Weights of Cyclic Codes," *Journal of Combinatorial Theory,* vol. 1, no. 4, pp. 459–475, 1966.
- (with E. Berlekamp and H. Rumsey) "On the Solutions of Algebraic Equations Over Finite Fields," *Information and Control,* vol. 10, pp. 553–564, 1967.
- "Self-Synchronizing Reed-Solomon Codes," *IEEE Trans. Inform. Theory,* vol. IT-14, no. 4, pp. 608–609, 1968.
- Introduction to Algebraic Coding. Part of Communication Theory Series edited by Balakrishnan. Published by Inter-University Series, McGraw-Hill Co., 1968.
- "The (7,5) R-S Code Over GF(2^3) is a (21,15) BCH Code," *IEEE Trans. Inform. Theory,* vol. IT-15, no. 4, pp. 619–620, 1969.
- "Coding with Character," R. C. Bose and T. H. Dowling, eds., *Combinatorial Mathematics and Its Applications*, Univ. of North Carolina Press, Chapel Hill, NC, pp. 405–415. 1970.
- (with D. J. Spencer) Error Correction/Multiplex for Megabit Data Channels, Volume I Analysis - Vol. II Implementation RADC-TR 17-176, Rome Air Development Center, September 1971.
- "Optimal Frequency-Hopping Sequences for Multiple-Access," *Proc. 1973 Symp. Spread Spectrum Comm,* vol. 1 AD-915, pp. 33-35, 1973.
- "A Note on Alphabet Codes and Fields of Computations," *Information and Control,* vol. 26, no. 4, pp. 395–398, 1974.
- "Decoding with Multipliers," *Proceedings 8th Annual Princeton Conference Information Science and Systems*, pp. 383–384, March 1974.

- (with R. W. D. Booth and M. A. Herro) "Convolutional Coding Techniques for Certain Quadratic Residue Codes," *Proceedings International Telemetering Conference*, Washington, D.C. Vol. XI, pp. 168–177, 1976.

- (with H. C. A. Van Tilborg) "A Connection Between Block and Convolutional Codes," *J. SIAM,* vol. 37, no. 2, pp. 358–369, October, 1979.

- (with M. M. Sweet) "A Golay Puzzle," *IEEE Trans. Inform. Theory,* vol. IT-29, pp. 174–175, Jan. 1983.

- "Generation of maximum distance separable codes," *TDA Progress Report 42-103,* July - September, 1990, Jet Propulsion Laboratory, Pasadena, California, November 15, 1990.

- "A (72,36;15) box code," *TDA Progress Report 42-112* October-December 1992, Jet Propulsion Laboratory, Pasadena, California, February 15, 1992.

- "Nonlinear, nonbinary cyclic group codes," *TDA Progress Report 42-108* October-December 1991, Jet Propulsion Laboratory, Pasadena, California, February 15, 1992.

- " Soft decoding a self-dual (48,24;12)," *TDA Progress Report 42-112* October-December 1992, Jet Propulsion Laboratory, Pasadena, California, February 15, 1992.

- "Golay and other box codes," *TDA Progress Report 42-109* January-March 1992, Jet Propulsion Laboratory, Pasadena, California, May 15, 1992.

- "More box codes," *TDA Progress Report 42-111* July-September 1992, Jet Propulsion Laboratory, Pasadena, California, November 15, 1992.

- "Self-dual (48,24; 12) codes," *TDA Progress Report 42-111* July-September 1992, Jet Propulsion Laboratory, Pasadena, California, November 15, 1992.

- (with R. J. McEliece) "Trace-Shortened Reed-Solomon Codes," pp. 23–36 in *Communications Theory and Applications II* (Selected papers from the 2nd International Symposium on Communication Theory and Applications, Ambleside, UK, July 1993), B. Honary, M. Darnell, and P. Farrell, eds. ©1994, HW Communications, Ltd.

- (with M. Hattori and R. McEliece) "Subspace subcodes of Reed-Solomon Codes, submitted to *IEEE Trans. Inform. Theory.*

PATENTS:

- *Error-Correcting Method and Apparatus* G. Solomon, J. J. Stiffler, T. O. Anderson, W. Lushbaugh.

  U.S. Patent No. 3,373,404. March 12, 1968. Property of NASA-JPL.

  A device for encoding and decoding a fixed number k of binary data symbols into any of the (n,k) block codes which exist for that k.

- *Error Correcting Decoder for Group Codes.* G. Solomon.

  U.S. Patent No. 3,818,442. June 18, 1974. Property of TRW Systems.

  A simple high speed error corrector utilizing the Solomon theory of multipliers.

- *Pulse Contour Measuring Instrument.* D. E. Royal, J. L. Sevy, G. Solomon.

  U. S. Patent No. 3,903,873. Sept. 8, 1975.

  An instrument for measuring the pulse contour of a warm-blooded animal and particularly of a human being.