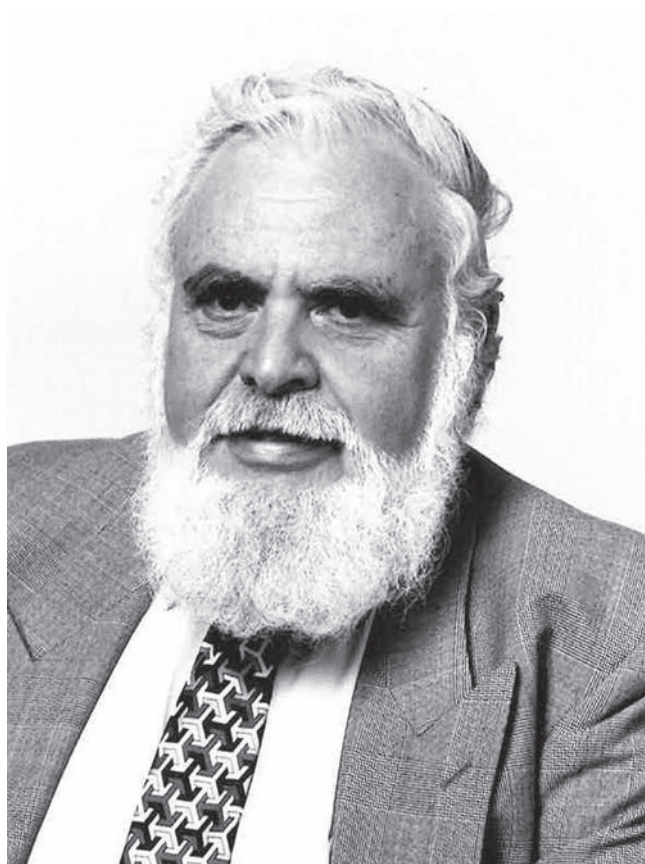




# SOLOMON W. GOLOMB

1932–2016

Elected in 1976

*“Contributions to space communications and  
information processing technology.”*

BY MARC BALLON AND DANIEL DRUHORA  
SUBMITTED BY THE NAE HOME SECRETARY

SOLOMON WOLF GOLOMB, a legendary and longtime electrical engineering professor at the the University of Southern California whose pioneering work in communication technology helped spark the digital communication revolution, died May 1, 2016, at age 83.

He was known for his singular ability to apply advanced mathematics to problems in digital communications. Video images from the Mars rover *Curiosity* owe a huge debt to his mathematical coding schemes, enabling pristine imagery transmitted back to Earth. His work on shift register sequences is integral to the function of cellular phones, while his cryptology research ushered in new approaches for securing communications signals.

The son and grandson of rabbis from Vilna (Vilnius), the capital of Lithuania, the Baltimore-born prodigy graduated from Johns Hopkins University with a BS in mathematics before his 19th birthday.

Pursuing his MS and PhD in mathematics at Harvard (1957, *Problems in the Distribution of the Prime Numbers*), he expected

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Adapted from a tribute prepared for the USC News of the University of Southern California. The authors appreciate input from Eric Mankin, Amy Blumenthal, and Adam Smith.

to travel the abstract route of pure mathematics. But during a stint working at the Glenn L. Martin Company he became interested in communications theory; then a Fulbright scholarship took him to Oslo, Norway, and his interests led him in a different direction.

He made his way to Caltech's Jet Propulsion Laboratory, where he and colleagues played a key role in formulating the design of deep-space communications for the subsequent lunar and planetary explorations. In 1961 a radar signal encoded with a Golomb-devised signal technology bounced off Venus. Years later eye-popping images started streaming in from the Red Planet; the tightly compressed communications packages traveling millions of miles to Earth are the fruit of his 1966 research. Without heavy-duty compression, it would be inconceivable to send crisp, data-rich photographs over the limited-power transmitters aboard the twin rovers *Spirit* and *Opportunity*.

Recruited simultaneously by UCLA, the California Institute of Technology, and USC, Golomb chose in 1963 to work at USC, explaining that "the question I asked myself was the one I ask my students: 'Where can you make the most difference?'"

Over the years, his efforts helped develop the school as a major center of communications research. He was one of the "Magnificent Seven" who founded the USC Communications Sciences Institute in 1982, and he served as vice provost for research from 1986 to 1989. He was honored as University Professor, Distinguished Professor of Electrical Engineering and Mathematics, and, in 1999, the first holder of the Andrew and Erna Viterbi Chair in Communications.

A polymath who spoke as many as 30 languages to varying degrees—among them Hebrew, Danish (his Danish wife would ask *him* for words in her native tongue), Norwegian (he read author Jo Nesbø's books in the original language), Swedish, Chinese and Japanese (which he learned in order to deliver invited presentations in each country on the US space program), German, and French—his enthusiasm and dedication extended beyond his highly technical research.

He enjoyed teaching inventive freshman seminars, such as “Puzzles, Patterns, Games, and Illusions.” He invented mathematical games such as “cheskers,” a hybrid of chess and checkers. And he was called “the godfather of Tetris” for creating polyominoes that inspired the invention of the tile-matching puzzle video game. With his Old Testament white beard, it seems fitting that he also occasionally taught a freshman seminar on the Book of Genesis. He continued to teach a freshman seminar into his 80s.

His students remember him as a brilliant man who cared deeply. Terry Lewis (PhD ’12) shared a story that conveyed the high esteem in which he held his mentor. A man, he said, was at the seashore and saw that thousands of horseshoe crabs had washed ashore and were dying. He began tossing them back into the sea. A passerby asked why he bothered to do so since there obviously too many to save. The man picked up another crab and threw it back into the water. “I just saved that one,” he said. “That’s what Sol did for me and for other horseshoe crabs like me,” Lewis said.

Tuvi Etzion, a former postdoctoral researcher of Golomb’s and current professor at the Technion–Israel Institute of Technology, said, “I never met and I will never meet someone with so much knowledge in mathematics, engineering, grammar, languages, history, and so many other areas in life.... I had the unbelievable honor to have him as my supervisor. Giants never die, they will always be in our memory and will always influence our life.”

In 1985 Golomb received the Shannon Award, the highest honor in information technology, and in 2000 the Richard W. Hamming Gold Medal, both from the Institute of Electrical and Electronics Engineers (IEEE). He was elected to both the National Academy of Engineering (1976) and National Academy of Sciences (2003). In 2013 he went to the White House to receive the National Medal of Science from President Barack Obama.

The month before his passing he received the 2016 Benjamin Franklin Medal in Electrical Engineering for his pioneering work in space communications and the design of digital

spread spectrum signals—transmissions that provide security, interference suppression, and precise locations for applications such as cryptography, missile guidance, defense, space and cellular communications, radar, sonar, and GPS.

He was also recognized as a fellow of the American Academy of Arts and Sciences, American Association for the Advancement of Science, and IEEE.

Colleagues offer heartfelt tributes:

“Professor Golomb was truly a giant in the field of mathematics and engineering,” said USC president C.L. Max Nikias. “He was an exceptionally imaginative thinker, and so many enduring innovations and highly creative games—including polyominoes and pentomino—emerged from his inimitable genius. But beyond the innumerable accomplishments, he was also a dear friend and colleague, having served on USC’s faculty for more than half a century. Indeed, he helped transform our university into the world-class institution it is today.”

“Sol’s impact has been extraordinary, transformative, and impossible to measure,” USC Viterbi Dean Yannis C. Yortsos said. “His academic and scholarly work on the theory of communications built the pillars upon which our modern technological life rests.”

George A. Bekey remembered his longtime friend as a Renaissance man who could speak knowledgeably about nearly any subject, from poetry to finance, from world politics to history. In addition, “He had a great sense of humor and a wonderful laugh,” Bekey said. “He leaves a huge gap in our faculty, since there is no one who could stand in his shoes.”

Sandeep Gupta, chair of electrical engineering–systems, said Golomb’s classic text *Shift Register Sequences* (Aegean Park Press, 1967) influenced his research. He not only admired Golomb for his towering intellect but also respected him for his personal decency and integrity, describing him as a “kind man who shared himself with all of us.”

Andrew Viterbi, USC Presidential Chair and professor of electrical and computer engineering, offered personal reflections. “I knew Solomon Golomb for over half a century; his was the first friendship I made on arriving in California in

1957. We collaborated at Caltech's Jet Propulsion Laboratory, where for a time he was my supervisor. Upon my arrival at the lab, Sol insisted on taking me apartment hunting for my parents and myself. Our friendship blossomed over the decades, with our wives and our children also becoming close friends.

"I learned a great deal from Sol, particularly on the mathematics of linear shift register sequences. Along with coding and information theory, this theoretical trio greatly influenced and enhanced the evolution of my career."

He added, "We've lost a great mind. A great heart and a great sense of humor. The universe will miss him as much as we will."<sup>1</sup>

Golomb's wife Bo died 2 weeks after he did. They are survived by daughters Astrid Golomb and Beatrice A. Golomb (Terrence J. Sejnowski).

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<sup>1</sup> Dr. Viterbi published a tribute to Dr. Golomb in *IEEE Transactions on Information Theory* 64(4):2837–38.