

In Memoriam— Dr. Lawrence J. Fogel

Truly few people have contributed to computational intelligence with the breadth and depth that Larry Fogel did.

You may know many of his contributions, but perhaps you may not know of his early career in engineering, which began at the age of 20 as he quickly became interested in helicopter antenna design. The noise of the main helicopter rotor was an impediment to clear communication. Larry came up with the idea of using a separate microphone to listen to the rotor, inverting that signal, and then using it to cancel out the noise in a main signal. He held some of the earliest patents in active noise cancellation.

This early fascination with human factors in engineering led him to study the field of bionics, which was also known at the time as “biotechnology.” Mimicking nature for problem solving was a natural path for Larry to dream of and pursue. In 1960, he devised an approach to creating intelligent machines by simulating evolution, modeling a process that gave rise to organisms of ever-increasing intellect over millions of years. His insight was to model the process of evolution itself, rather than ourselves as an endpoint of evolution. He published and advanced this “evolutionary programming” concept widely, including in the first doctoral dissertation in evolutionary computation (UCLA, 1964) and the first book in the field, *Artificial Intelligence through Simulated Evolution*, published by John Wiley in 1966, co-authored with Alvin Owens and Michael Walsh.

At the same time, he grew more involved in the Institute of Radio Engineers (IRE), the forerunner of today’s IEEE. At the age of just 26, he had been a founding member of the publication committee and associate editor (the only one with this title) for the *Transactions of the IRE Professional Group on Engineering Management* (1954–1956). In 1960, he became a member of the founding editorial board of the *IRE Transactions on Human Factors in Electronics*. He stayed on the editorial board as this publication transitioned to the IEEE in 1967 and became the *IEEE Transac-*

tions on Man-Machine Systems (a predecessor to today’s *Systems, Man, and Cybernetics*). In 1963, he published the then-definitive treatment of bionics in the book *Biotechnology: Concepts and Applications* (Prentice-Hall).

These accomplishments alone would be deserving of tribute, but Larry went beyond these academic activities. His was the viewpoint of a practicing engineer, and so he started his own company in 1965, Decision Science, Inc., together with Owens and Walsh and others, to advance evolutionary programming as a means for



Dr. Lawrence J. Fogel while on leave of absence from General Dynamics to the Office of the Director, National Science Foundation in 1960 at roughly the time when he invented an approach for simulated evolution known as evolutionary programming.

solving real-world problems. Most companies fail in the first year, and yet despite having computers that were at first only perhaps half the speed of an Apple II, his company was successful, surviving 17 years before being acquired by Titan Systems, Inc. in 1982.

During this time, Larry not only ran his company, but also founded a new journal, the *Journal of Cybernetics* (a predecessor to today's *Cybernetics and Systems*), taught a variety of courses at colleges in San Diego, California, and served on panels for the U.S. government. His keen insights were appreciated by many people.

One of Larry's greatest gifts was the gift of lecturing. He was a master. I have heard many stories from people who had seen him lecture in years past, with each maintaining a vivid memory of the event. Part of his talent was a natural enthusiasm and passion for what he was doing, and he wanted to share those feelings with the audience. I regret not seeing him finish one of his lectures with his characteristic singing of Cole Porter's "Experiment." Larry was both a scientist and orator, but he was also an entertainer.

Larry continued to advance evolutionary computation throughout his time at Titan Systems, Inc. (1984–1987), while starting his son David on the same path. Larry and David continued working together at another company, ORINCON Corporation, for five years (1988–1993) before leaving to start Natural Selec-



Warren S. McCulloch turns over the gavel of the presidency of the American Cybernetics Society to Larry Fogel on May 14, 1969 at a meeting in Toronto, Canada. Larry was the second president of ASC. Looking on from left to right are: Van Douglass, Alex Fraser (also a pioneer in evolutionary computation), and B. B. Goodfellow. (photo from ASC Newsletter, February 1970).

tion, Inc., which continues now as one of the leading companies in computational intelligence. The odds of starting two companies that last more than a decade are extremely small. The chance of success when starting a company at age 65 is also small. Larry accomplished both.

It was my great pleasure to have met Larry on a few occasions as part of my IEEE activities. His long record of distinction, including election as an IEEE Fellow (the first from the area of evolutionary computation), and recognition via the Evolutionary Programming

Society's Lifetime Achievement Award, the SPIE Computational Intelligence Pioneer Award, the inaugural IEEE Neural Network Council's Evolutionary Computation Pioneer Award, and most recently the inaugural IEEE Frank Rosenblatt Technical Field Award, was well known to me. But what I remember most is his kindness, friendliness, open mindedness, curiosity, and confidence in the future.

Larry was an inspiration for all of us: we have lost a great friend, but we will always have a great example to follow.



In Memoriam—Reflections on Larry Fogel at Decision Science, Inc. (1965–1982)

Larry Fogel—A Lucky Combination of Natural and Artificial Intelligence, and Humanity

This article consists of two parts: In a first section, I offer some reminiscences about my work with Larry (and his coworkers, Al Owens

and Jack Walsh) while Larry was president of Decision Science, Inc. (DSI). Our common work was centered on evolutionary programming: its application to multiplayer games (such as air-to-air combat and missile evasion

tactics), analysis of time series, system identification, and similar areas. In a second, shorter section, I will jump some 40 years forward in time from the early days of DSI to the very last days of Larry's life, when we worked together

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