Gene H. Golub, 1932-2007

by
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Professor Gene Golub, one of the most influential numerical analysts of our time, died on November 16th, 2007 at Stanford Hospital in California, after being diagnosed just a few days earlier with leukemia. His sudden death sent shock waves throughout the scientific community. Within a week of his death, nearly 200 touching farewell postings of friends and collaborators were recorded in a special memorial Webpage: http://genehgolub.blogspot.com/.

Born in Chicago to Eastern European immigrants on February 29, 1932 (a leap day that made him quite special even when he was born), he received his PhD in 1959 from the University of Illinois, an institution he always cherished. His academic career spanned over four and a half decades of active research as a professor at Stanford University. His contributions were primarily in the field of numerical linear algebra, or "Matrix Computations" as he preferred to call the field. But the algorithms he developed were applicable in numerous important applications in science and engineering.

Among Golub's major contributions, most notable was his joint work with Kahan in the mid 1960s (and other papers that followed, with other collaborators) which showed how to compute the ubiquitous singular value decomposition (SVD) in a numerically stable fashion. Following that work, the SVD has become a major computational resource not only in mathematical areas but also in psychology, Internet search engine technology and document analysis, biology, and many other disciplines; entering "singular value decomposition" on Google Scholar at the time of preparing this piece has resulted in approximately 70,000 hits. Golub was so identified with the SVD that he proudly and famously featured the license plate 'PROF SVD' on his car.

Another area where Golub made an enormous impact is the field of fast solvers for sparse large linear systems. Such systems are known to form the computational bottleneck in many numerical (linear as well as nonlinear) processes. Here we note semi-iterative methods (joint with Varga, 1961), the Fast Poisson Solver (joint with Buzbee, Dorr and Nielson, 1970), and Golub's prominent role in developing and popularizing variants of the preconditioned conjugate gradient method (joint papers with Concus, 1975, and with Concus and O'Leary, 1976).

The solution of least squares problems, which are widely used in statistics and many other disciplines, is another area where Golub's impact was significant. His early papers paved the way to a numerically stable computation of their solution, based on the celebrated QR factorization. The total least squares problem was also introduced by Golub and his collaborators - a model based on the assumption that the discrete operator that represents the quantity to be minimized might be inaccurately represented, that is, data measurements are often not the only source of errors. This approach has practical importance in

a variety of fields of applications such as medical imaging. (The catchy name and the paper that popularized this approach was joint with Van Loan, 1980.)

One of Golub's trademarks was to connect several areas of research by unifying themes, and at the same time to keep looking for new directions. His work on moments and quadrature rules in the mid 1980s, which is of great mathematical beauty, goes beyond the computation of integrals and actually makes a strong connection between quadrature and eigenvalue and eigenvector computations. Another example here is a well known paper in 2002 which proposed an accelerated scheme for computing Google's PageRank, and triggered a great interest of the numerical linear algebra community in the PageRank problem. And of course, "Matrix Computations" by Golub and Van Loan, now in its third edition, has sold tens of thousands of copies and can be found in the library of almost any numerical analyst and many other scientists.

But beyond Golub's contributions to the wide field of scientific computing by way of writing papers and books, what made him so dominant was his personal style and his commitment to his community. He spent an enormous amount of energy in popularizing numerical algorithms, continually travelling to all corners of the world, disseminating research results in his lectures, and connecting people with each other. He served as President of SIAM and was one of the founders of the International Council for Industrial and Applied Mathematics (ICIAM). He was the founding editor of two important journals–SIAM Journal on Scientific Computing and SIAM Journal on Matrix Analysis and Applications. And he was the founder of NA-Digest.

Golub was widely recognized and honored for his pioneering work. He was a member of the National Academy of Sciences and the National Academy of Engineering, and recently was nominated for the most prestigious honour in the field of computer science: the Turing Award. He also received ten honorary doctorates. Sadly, his death came just before he was scheduled to receive another honorary degree which was particularly precious to him, at ETH Zurich.

Gene the person was complex and multidimensional. He could be friendly and entertaining, but also very demanding. He will be fondly remembered for being generous and helpful to generations of young scientists, for creating numerous collaborations, for the constant stream of visitors, his hospitality and the many parties he held in his house, and for making Stanford the 'Headquarters'. All this has made him a household name in the numerical analysis community. The Canadian scientific community has also benefited from his activities, thanks to his involvement in founding ICIAM which is now of much importance to CAIMS (the next ICIAM meeting will be held in Vancouver in 2011). We also note his lifelong collaboration and connection with a few of Canada's finest numerical analysts, such as Alan George, Chris Paige, and Jim Varah.

On the day of Gene's death a few of us got together, to digest the shocking news and exchange memories. Our conversation quickly revealed that Gene had a direct impact on the career paths of most of us. This encapsulates the essence of his role in our community. His presence and impact were unparalleled, and many of us are indebted to him for his support and generosity. The numerical analysis community has lost a prominent leader and ambassador.