GENE H. GOLUB
1932–2007

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Gene Howard Golub, professor in the Computer Science Department of Stanford University (USA) passed away suddenly from an acute myeloid leukemia in the Stanford Hospital on November 16, 2007. Gene was one of the prominent figures of numerical linear algebra or, as he preferred to call it, matrix computations.

Gene was born in Chicago (Illinois) on February 29, 1932, from parents who emigrated from Ukraine and Latvia to the United States in 1923. He did his graduate studies first in the University of Chicago and then, from 1953 to 1959, in the University of Illinois at Urbana-Champaign. There, he studied matrix theory and statistics. He had a partial time job in the computer center and learn how to program one of the first parallel computers, the ILLIAC IV. For a while he was considering doing a Ph.D. in statistics but he became a student of Professor Abraham Taub, an applied mathematician, who oriented him toward the study of Chebyshev polynomials for solving linear systems, starting from John von Neumann's works. In 1959 Taub invited Richard Varga to the University of Illinois and Gene discovered that Varga was working on the same topic. This lead to the writing of a seminal joint paper that was published in 1961.

After his Ph.D. thesis Gene received an NSF fellowship that allowed him to spend 15 months in Cambridge (UK) where he met for the first time Jim Wilkinson who was working at the National Physical Laboratory. Jim became a prominent expert in rounding error analysis in numerical linear algebra algorithms and a frequent visitor to Stanford. Gene met also Cornelius Lanczos in the UK. When he was back to the US, he worked for several industrial companies and then decided to back to academics. In 1962, George Forsythe offered him an assistant professorship in Stanford and soon a permanent position. It was in these times that Gene met some of Forsythe's students that were about to become famous like Cleve Moler (founder of Matlab and present SIAM president) and Beresford Parlett. The Stanford University Computer Science Department was founded by Forsythe in 1966 and Gene naturally get a position in the department together with John McCarthy, Donald Knuth and other well–known researchers. He was chairman of the department in 1982.

During his brilliant career Gene authored or co–authored more than 180 papers published in the best journals and many contributed or invited papers to an uncountable number of international conferences. It is almost impossible to summarize all of his many important contributions to applied mathematics. Perhaps the most well–known ones are the use of QR factorizations to solve least squares problems and the invention of direct and iterative algorithms for the computation of the singular value decomposition (SVD) together with W. Kahan. SVD was a great passion of Gene and he used it in many applications. He was so in love with SVD that the license plate of his last car was "Pr. SVD". Noticeable also is the discovery of the cyclic reduction algorithm for solving certain structured linear systems leading to the construction of fast Poisson solvers. Gene was one of the most active evangelists for the preconditioned conjugate gradient algorithm through his joint papers with P. Concus and D.P. O'Leary. More recently he worked on algorithms for computing bounds or estimates of bilinear forms $u^T f(A)v$ where u and v are vectors, A is a square

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matrix and f is a smooth function. The techniques he developed rely on subtle relationships between moments, Gauss quadrature, orthogonal polynomials and Lanczos algorithms. Applications of these methods are found in approximation of error norms in the solution of linear systems, computation of parameters in Tikhonov regularization of ill–posed problems, as well as the generalized cross–validation algorithms and computing approximations of the determinant of large sparse matrices.

Gene Golub is also the author of several well–known books, the most famous of which is Matrix Computations [1], written in collaboration with Charles Van Loan. This book is a masterpiece and can be considered as the bible of modern matrix computations. Three editions had already been published since 1983 and a fourth one was about to come. This book sold more than 50000 copies and if one type "Matrix Computations" in Google Scholar, more than 20000 citations are listed. Reference [2] contains reprints of several of Gene's papers, chosen by himself as being the most representatives of his work and commented by some of his colleagues. It contains also an interesting detailed biography. An obituary was published in the New York Times on December 10, 2007. It is also interesting to read references [3] and [4]. Interviews with Gene are available at *http://history.siam.org/oralhistories/golub.htm* and *http://www.maths.manchester.ac.uk/ higham/papers/*.

Gene was very much concerned with the applied mathematics community. He was president of SIAM and founded two of SIAM journals: SIAM Journal on Scientific Computing (SISC) and SIAM Journal on Matrix Analysis and Application (SIMAX). He was a member of editorial boards of many journals including Numerical Algorithms. He was also a driving force at the beginning of the International Council for Industrial and Applied Mathematics (ICIAM) and participated actively in the organization of the first conference in Paris in 1987. He was closely involved in the organization of the first conferences on domain decomposition methods. He received more than ten diplomas and awards from universities around the world. He was elected to the US National Academy of Sciences in 1993 and the National Academy of Engineering in 1990.

Gene was travelling a lot around the world to participate in the many conferences to which he was invited and to meet his many collaborators. He was also spending a lot of time sending e-mail and answering to the tens of messages he received a day. He was a pioneer in this area and so interested in it that he founded NA-net and the NA-digest to help the distribution of information through the community. Besides being an exceptional applied mathematician Gene was also a remarkable man. During meetings and conferences he spent probably more time with young students than with distinguished old professors. I am sure many people remember his "Hello, I'm Gene Golub, who are you and what are you doing?". He had a lot of influence on the carrer and life of many of us. He was also very generous for his many friends around the world. He was a great scientist and a very nice friend.

Meetings were organized in 31 locations around the world on February 29, 2008, the date that would have been his "19th" birthday (see *www.cs.nyu.edu/overton /genearoundtheworld/*). More than 1000 people attended these meetings and gave scientific talks or rememberings to celebrate Gene's remarkable life and scientific work.

Dear Gene, we miss you!

REFERENCES

[1] G.H. Golub and C. Van Loan, *Matrix Computations*, Third Edition, Johns Hopkins University Press, (1996).

[2] R.H. Chan, C. Greif and D.P. O' Leary Eds, *Milestones in matrix computation, the selected works of Gene H. Golub with commentaries*, Oxford University Press, (2007).
[3] D.P. O'Leary, *Gene Howard Golub, 1932-2007*, Linear Algebra and Its Applications, v 428 pp 2405–2409, 2008.
[4] L.N. Trefethen, *Gene H. Golub (1932-2007): Mathematician and godfather of numerical analysis*, Nature, Vol 450, 13 December 2007.