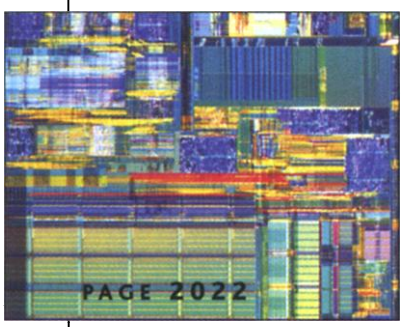
A Computer Science Odyssey

Walk into any university department or research center and one universal and indispensable piece of scientific equipment will greet you at every turn: the computer. Once primarily a word processor and graphics aid, the computer has evolved—in just a few years for most scientists—into an all-purpose scientific tool. It is essential for collecting and analyzing data, reading and searching the scientific literature, publishing papers, and communicating with peers. Computer technology has facilitated the collection of data so well that now, in a growing number of fields, the availability of data is no longer (or soon will not be) the limiting factor for addressing fundamental scientific questions. Paradoxically, the new limitation is computer technology: Only with the help of computer science can we make sense of the masses of data that computers have enabled us to collect, and share and discuss the data with colleagues around the globe. The challenge is now to design aids to help us comprehend data so complex or interconnected that we cannot organize, integrate, or understand it alone.

This special issue focuses on this frontier as well as some other emerging opportunities and threats to how science is practiced and conducted within the broad scope of computer science. Some aspects of computer science, such as numerical modeling and data visualization, have been in the forefront of scientific research in many fields essentially since the first computers were developed (*Science*, 11 May 2001, p. 1044; 2 August 1996, p. 585; and 8 September 1995, p. 1353). Others, the focus here, have been incubating for some time, or are just being developed because of the new need to comprehend enormous data sets.



Several Viewpoints examine the emerging problem of data integration and analysis in different fields, from astronomy, where a personal computer may soon act as a virtual telescope, to biology, where means are being developed to comprehend enormous amounts of newfound genomic and functional data. In addition, computers are being created that can learn on the job, allowing increased flexibility in data analysis and collection. New ways of searching for data and scientific resources are also emerging, driven largely by the scientific-publishing industry. Although it is clear that computers have changed science, they perhaps have changed society as well. Treaties and laws are being created to respond to the new technology, and some of these efforts are posing challenges for scientists and science.

So far, almost all computers have been based on silicon chips, and their speed has been increasing exponentially. Are we now approaching the theoretical limit of silicon-based technology, where alternatives like quantum computing may be necessary? If so, how are the main chip manufacturers responding? Will quantum computing be a viable solution and affect most scientists? Several Viewpoints and News stories provide some answers and prospects.

In 2001 computers have not yet seized control, or perhaps they have in ways we are just beginning to recognize. **–BROOKS HANSON AND ROBERT COONTZ**

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See also NetWatch on p. 1959, Reports on p. 2059 and p. 2087, and www.sciencemag.org/feature/data/compsci/index.shtml

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