The Computer

from Pascal to von Neumann

Herman H. Goldstine

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Preface (1993)

It is now over twenty years since the first edition of this book appeared; in that period the world has been totally changed by the impact of the computer on our ways of thinking and acting. We all know, or at least sense, the many ways in which computer technology and its applications have modified our lives and ways of thought. They are so manifold that it would serve no useful purpose for me to detail examples here.

Before examining some of the changes, let us first see what—if anything—has stayed invariant since the beginnings of the modern computer period. Perhaps most remarkable from our point of view is that the basic logical structure of the computer has by and large remained unaltered since its inception. This means that the logical design ideas discussed in this volume still have the same basic validity that they did when originally formulated.

Let us now look hastily at those things which have altered. Many of the enormous advances have been made possible by two marvelous technological developments: it was realized that the computer really processed information, not just numbers; and new hardware was invented that changed the entire inner economy of the computer, making it so inexpensive that it is now accessible to the average person, not just to the scientist.

The computers discussed in this book were based on a computing economy of very speedy arithmetic operations and very little speedy memory. This led to a need for numerical analytic techniques to suit that economy. Our numerical orientation dominated our thinking in the field's incipient days. Indeed, we envisioned the computer as the tool that would free people from the drudgery of scientific computation. This was the case, even though Alan Turing had already begun to move beyond the purely mathematical when he devised his well-known test to determine whether a human or a computer was responding to an interrogation.

This mathematical approach gave way during the decades since this book first appeared to informationally oriented points of view. Thus the world has moved into our present era both because of wonderful new technological advances in the form of

cheap, powerful, and fast circuits and through the adoption of the simple idea that the key thing to process was information, not numbers. Thus the bit gave way to the byte.

We need to say just a few more words about our present computational environment, made possible by an incredible series of advances in technology: each year the price of a byte of memory has become so much cheaper that even the ubiquitous typewriter of James Barrie's "The Twelve-Pound Look" is now more properly found in a museum rather than an office. The so-called desk-top computer or PC is capable of doing virtually everything the typewriter could do and much more, at a comparable price; further, desk-top technology affects virtually every product we buy. Even our children in the earliest grades are using these instruments meaningfully. We are thus all participants—whether we like it or not—in the Computer Revolution.

The other great realization has been that the basic structure of the computer, now known as the von Neumann architecture but described by Burks, von Neumann, and myself, is so powerful that many of the manifold tasks of the business world can be met by very efficient computers that greatly increase the productivity of virtually every employee in every store and company. It is only just now that we hear of the advent of highly parallel computers which represent a new architectural type, built up by yoking together concurrently many von Neumann–type machines. Such machines are not discussed in the succeeding pages. Although the ENIAC was also a parallel machine, these new machines represent an enormous step beyond it.

H.H.G.

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