

# Introduction

*If it should turn out that the basic logics of a machine designed for the numerical solution of differential equations coincide with the logics of a machine intended to make bills for a department store, I would regard this as the most amazing coincidence I have ever encountered.*

–Howard Aiken 1956<sup>1</sup>

*Let us now return to the analogy of the theoretical computing machines . . . It can be shown that a single special machine of that type can be made to do the work of all. It could in fact be made to work as a model of any other machine. **The special machine may be called the universal machine . . .***

–Alan Turing 1947<sup>2</sup>

In the fall of 1945, as the ENIAC, a gigantic calculating engine containing thousands of vacuum tubes, neared completion at the Moore School of Electrical Engineering in Philadelphia, a group of experts met regularly to discuss the design of its proposed successor, the EDVAC. As the weeks went by, the meetings grew increasingly acrimonious, with the experts finding themselves divided into two groups they dubbed the “engineers” and the “logicians.” John Presper Eckert, leader of the “engineers,” was justly proud of his accomplishment with the ENIAC. It had been thought impossible for 15,000 hot vacuum tubes to work together long enough without any of them failing, for anything useful to be accomplished. Nevertheless, by using careful conservative design principles, Eckert had succeeded brilliantly in accomplishing this feat. Things came to a head when, much to Eckert’s displeasure, the group’s leading “logician,” the eminent mathematician John von Neumann, circulated, under his own name, a draft report on the proposed EDVAC that, paying little attention to engineering details, set forth the fundamental *logical* computer design known to this day as the von Neumann architecture.

Although an engineering tour de force, the ENIAC was a logical mess. It was von Neumann’s expertise as a logician and what he had learned from the English logician Alan Turing that enabled him to understand the fundamental fact that a computing machine is a logic machine. In its circuits are embodied the distilled insights of a remarkable collection of logicians, developed over centuries. Nowadays, when computer technology is advancing with such breathtaking rapidity, as we admire the truly remarkable accomplishments of the engineers, it is all too easy to overlook the logicians whose ideas made it all possible. This book tells their story.