where the costs to develop a product are well known. A cost-plus contract is more appropriate for nascent industries where a brand-new product is still being developed. Unfortunately for Eckert and Mauchly, EMCC negotiated a fixed-price contract for $270,000 with the U.S. Bureau of Standards (on behalf of the Census Bureau) for the first UNIVAC machine. By the time it was completed, however, EMCC had spent $900,000 developing it.

The BINAC

During the development of the first UNIVAC, EMCC realized it was running out of money fast. Scrambling for additional funding, Eckert and Mauchly agreed to build a small computer, called the **BINAC** (Binary Automatic Computer), for Northrop Aircraft Company. They optimistically hoped that they could develop both the BINAC and the UNIVAC computers at the same time without falling too far behind schedule. In their desperation, Eckert and Mauchly negotiated another woefully inadequate fixed-price contract for the BINAC, with a price tag of $100,000. In the end, EMCC spent $280,000 to develop the BINAC.

The BINAC was a functioning computer when EMCC completed it in 1949; EMCC tested it internally to make sure. It was taken apart before being shipped to Northrop, whose engineers then put it back together on-site. Tragically, the BINAC did not work properly for Northrop. The exact reason is unknown: it may have been damaged in transit, or perhaps Northrop re-assembled it incorrectly. Both companies blamed the other. In any case, Northrop stowed away the BINAC in a warehouse and never put it into production.

Acquisition by Remington Rand

Still short on cash, in 1950 Eckert and Mauchly visited IBM, offering IBM a majority stake in EMCC. IBM, which by this time had already started developing its own line of computers, turned them down. Not long afterward, James Rand Jr., the president of the typewriter company Remington Rand, met with Eckert and Mauchly. Under Rand's leadership, Remington Rand had acquired a number of other companies and by this time offered a full line of office equipment—including punched-card tabulating machines that competed with IBM's. Eager to expand Remington Rand into the new field of electronic computing, Rand Jr. offered to pay off EMCC's debts and buy the company outright. Eckert and Mauchly accepted the

offer, and EMCC thus became a division of Remington Rand rather than an independent company.

An amusing quote attributed to Mark Twain seems applicable here: "Very few things happen at the right time, and the rest do not happen at all. The conscientious historian will correct these defects." The first stored-program computer *should have* been the EDVAC; after all, it was the lineal successor to the original ENIAC. Instead, the Manchester Baby and the EDSAC, built on the other side of the world, staked that claim. Likewise, the UNIVAC *should have* gone down in history as America's first commercially produced computer. Instead, the small, inoperative BINAC has that distinction. Finally, Eckert and Mauchly, pioneers of the computer age, *should have* gained fame and prosperity from their invention, rather than being saved from bankruptcy by an office equipment company. Unfortunately, unlike Mark Twain's "conscientious historian," we are obliged to tell the story as it really happened, not as we would have liked it to happen.

The Completion of the UNIVAC

Finally, in March 1951, the first UNIVAC was completed. Perhaps to avoid the same difficulties that plagued the BINAC, the Census Bureau opted to keep its UNIVAC on-site at EMCC rather than have it shipped to its location. The UNIVAC was superior to the ENIAC in every conceivable way: it used high-speed magnetic tape for input and output, not just paper punched cards. It also used only five thousand vacuum tubes compared to ENIAC's 18,000.

On election night in November 1952, Remington Rand pulled off a very successful publicity stunt. The company persuaded the television network CBS to use a UNIVAC computer to predict the results of the presidential election on live television. Legendary anchorman Walter Cronkite hosted the event. Taking early results from a handful of districts in just eight states, Remington Rand programmers loaded the data into the UNIVAC and tabulated the results. At 8:30 PM that evening, the computer predicted 438 electoral votes for Dwight D. Eisenhower and only ninety-three for Adlai Stevenson—a landslide victory.

This result surprised both the staff of Remington Rand and CBS because a public opinion poll conducted just the previous day had predicted a much closer race. To avoid embarrassment, both Remington Rand and

Glossary

---

adding machine – an early form of mechanical calculator, mass-produced in the early twentieth century and sold as office equipment; most models supported the basic operations of addition, subtraction, multiplication, and division; later iterations were electromechanical rather than purely mechanical.

algorithm – a precise, step-by-step list of instructions for accomplishing a given task; algorithms are key to computer science: a program is simply an algorithm expressed in computer code.

Analytical Engine – a mechanical calculating machine that was designed by Charles Babbage, but was never completed during his lifetime; the successor to the simpler Difference Engine, the Analytical Engine was to be a general-purpose computer capable of performing any algorithm.

artificial intelligence – the science and practice of developing algorithms that allow computers to perform actions that normally require human intelligence; often abbreviated AI; playing chess was one of the original applications of AI; today, research in AI has resulted in self-driving cars and virtual assistants like Siri and Alexa; however, achieving true human-level intelligence continues to be an elusive goal.

assembly language – a shorthand syntax for writing computer programs, intended for the convenience of programmers; in assembly languages, individual binary machine-level instructions are represented by short alphanumeric mnemonic symbols; the assumption is that assembly instructions are easier for programmers to learn than the arbitrarily numbered machine language instructions.

Atanasoff-Berry Computer – an early electronic computer, built in 1941 by John Atanasoff and Clifford Berry; often abbreviated ABC; although not a general-purpose device and never fully operational, the ABC was declared prior art by Judge Earl Larson in 1973, thus invalidating the ENIAC patent and placing the invention of the computer in the public domain.

batch-oriented computing – a mode of operating a computer in which multiple programs are prepared ahead of time and then delivered to an operator who runs the programs sequentially on the computer; the output of each program is printed on paper and returned hours or days later to the programmer; in contrast to interactive computing, batch-oriented computing focuses on using the computer's—rather than the users'—time efficiently.

BINAC – an early electronic computer, manufactured in 1949 by the Eckert-Mauchly Computer Corporation (EMCC); only one BINAC was ever produced (made for Northrop Aircraft Corporation).

bitmapped display – a form of visual computer display in which the visual area is divided into thousands or millions of tiny dots of light, called pixels; this allows complex images to be shown on the screen, as well as text; in contrast, a vector display draws images as a set of individual lines and curves, which only permits simple shapes to be drawn on the screen.

Brooks's Law – Coined by Fred Brooks to describe the challenges he faced when managing the OS/360 project for IBM, Brooks's Law states: "Adding manpower to a late software project makes it later."

clone (PC) – a computer that is designed to be 100 percent compatible with another computer made by a different manufacturer; the most commonly cloned computer is the IBM PC; in 1982, Compaq produced the most successful of the first wave of IBM PC clones; clones eventually surpassed the original IBM PC in sales. In 2005, IBM stopped manufacturing PCs entirely, but the PC platform itself lives on through its clones.

cloud computing – similar to timesharing, a form of outsourcing wherein an organization does not operate its own servers on-site, but rather pays for computer time and storage on another organization's servers