Chapter 5
The First Commercial Computers

Key Topics
UNIVAC I
LEO I computer
Ferranti Mark I
Z4
CSIRAC

5.1 Introduction

This chapter considers a selection of the first commercial computers designed and developed in the United States, Great Britain, Germany, and Australia. These machines built on the work of the first computers developed during the Second World War.

We discuss the UNIVAC I computer developed by EMCC (later called Sperry and Unisys) in the United States, the LEO I computer developed by J. Lyons and Co. in England, the Z4 computer developed by Zuse KG in Germany, the Ferranti Mark I developed by Ferranti in England, and the CSIRAC developed by CSIR in Australia.

The UNIVAC I computer was designed by John Mauchly and Presper Eckert of EMCC for the US Census Bureau, and it was designed for business and administrative use.

The LEO I computer was developed by J. Lyons and Co. in partnership with Cambridge University in England. It was based on the EDSAC computer designed by Maurice Wilkes at Cambridge University, and it was designed for business use.

The Z4 was designed and developed by Konrad Zuse in Germany. Zuse had already designed and developed a number of machines, and the Z4 computer was almost complete at the end of the Second World War. Zuse formed Zuse ZG to complete the machine after the war.

The University of Manchester implemented the first stored program computer (discussed in previous chapter), and the British government encouraged Ferranti to commercialize the Manchester Mark I.

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5.2 UNIVAC

The Eckert-Mauchly Computer Corporation (EMCC) was founded by Presper Eckert and John Mauchly in 1947 after their resignations from the University of Pennsylvania. It was one of the earliest computer companies in the world, and it pioneered a number of fundamental computer concepts such as "*stored program,*" "*subroutines,*" "*programming languages,*" and "*compilers.*"

EMCC was awarded a contract from the US Census Bureau in 1948 to develop the *Universal Automatic Computer* (UNIVAC) for the 1950 census. This was one of the first commercially available computers when it was delivered in 1951 (too late for the 1950 census), and it was designed for business and administrative use, rather than for complex scientific calculations. The UNIVAC machine was later used to accurately predict the result of the 1952 presidential election in the United States (Dwight Eisenhower's landslide victory) from a sample of 1% of the population.

The UNIVAC I (Fig. 5.1) was initially priced at $159,000, and the price gradually increased over the years to reach between $1.2 and $1.5 million. Over 46 of these computers were built and delivered.

It employed magnetic tape for high-speed storage, and it used 5,200 vacuum tubes. It consumed 125 kW of electricity, and it could carry out over 1000 operations per second. It took up 400 square foot of space, and its main memory consisted of 1000 words of 12 characters. The input/output was via the operator's console; several tape drives; and an electric typewriter.

UNIVAC is the name of a series of digital computers produced by EMCC and its successors (i.e., Remington Rand, Sperry, and Unisys). The original model was the UNIVAC I (Universal Automatic Computer I). The successor models in the original

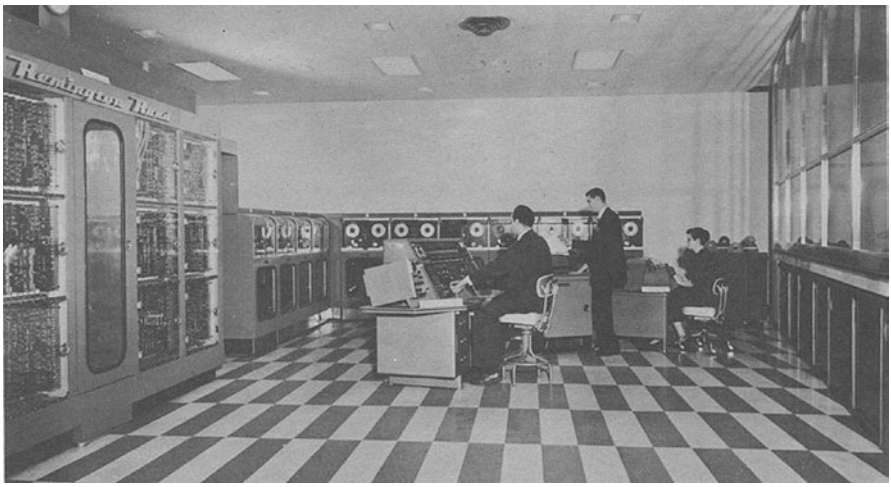

Fig 5.1 UNIVAC I computer

UNIVAC series included the UNIVAC II, which was released in 1958, and the UNIVAC III, which was released by Sperry Rand in 1962.

EMCC set up a department to develop software applications for the UNIVAC computer, and it hired Grace Murray Hopper in 1949 as one of its first programmers. Hopper played an important role in the development of programming languages, and she made important contributions to the early development of compilers, programming language constructs, data processing, and the COBOL programming language. She had previously worked with Howard Aiken on the Harvard Mark I computer, which was discussed in Chap. 4. For more information on Grace Murray Hopper, see [ORg:13].

EMCC was taken over by Remington Rand in 1950. Remington had a background in the production of typewriters, and *the Remington Typewriter was the first to use the* QWERTY *keyboard*. Remington's acquisition of EMCC allowed it to enter the electronics market, and EMCC became the UNIVAC division of Remington Rand. Sperry took over Remington Rand in 1955, and it became known as Sperry Rand (and later just Sperry).

5.3 LEO I Computer

J. Lyons and Co. was an innovative and forward thinking British company, and it was committed to finding ways to continuously improve to serve its customers better. It sent two of its executives to the United States shortly after the Second World War to evaluate new methods to improve its business processes. These two executives came across the early computers that had been developed in the United States, including the ENIAC computer that had been developed by John Mauchly and others. They recognized the potential of these early machines for business data processing.

They also became aware during their visit that Maurice Wilkes and others at Cambridge University in England were working on the design of a computer based on the ideas detailed in Von Neumann's report. On their return to England, they visited Wilkes at Cambridge University, who was working on the design of the EDSAC computer. They were impressed by his ideas and technical knowledge, and the potential of the planned EDSAC computer. They prepared a report for Lyon's board recommending that a computer designed for data processing should be the next step in improving business processes, and that Lyons should develop or acquire a computer to meet its business needs.

Lyons and Cambridge entered a collaboration arrangement where Lyons agreed to help fund the completion of EDSAC, and Cambridge agreed to help Lyons to develop its own computer, which was called the Lyons Electronic Office or LEO Computer (Fig. 5.2). This machine was based on EDSAC but adapted to business data processing. Lyons set up a project team led by John Pinkerton to develop its computer, and Wilkes provided training for Lyon's engineers. The LEO computer ran its first program in late 1951.

The Electronic Delay Storage Automatic Calculator (EDSAC) was completed and ran its first program in 1949, and the LEO I computer was completed and ran its first program in late 1951. Lyons developed several applications for LEO, and the computer was used to process business applications (e.g., payroll) for other companies. Lyons recognized that more and more companies would require computing power, and they saw a business opportunity. They decided to set up a subsidiary company to focus on computers for commercial applications

Leo Computers Ltd. was set up in 1954 and it was based in London. It designed and developed a new computer, the LEO II, which was purchased by several British companies. The LEO III was released in 1961, and it was sold to customers in the United Kingdom and overseas.

LEO I's clock speed was 500 kHz with most instructions taking 1.5 milliseconds to complete. The machine was linked to fast paper tape readers and fast punched card readers and punches. It had 8.75Kb of memory holding 2048 35-bit words

The LEO I was initially used for valuation jobs, but this was later extended to payroll, inventory, and other applications. One of the early applications developed by Lyons was an early version of an integrated management information system to manage its business. Lyons was also one of the pioneers of IT outsourcing in that it performed payroll calculations for a number of companies in the United Kingdom.

The UK Met Office used the LEO I computer in an early attempt at using a computer for weather forecasting in the early 1950s. The weather prediction model was solved on the LEO I computer, and the first predictions were made in 1954. The Met Office later used the Ferranti Mark I and more powerful computers for weather forecasting. For a more detailed account of LEO, see [ORg:15, Fer:03].

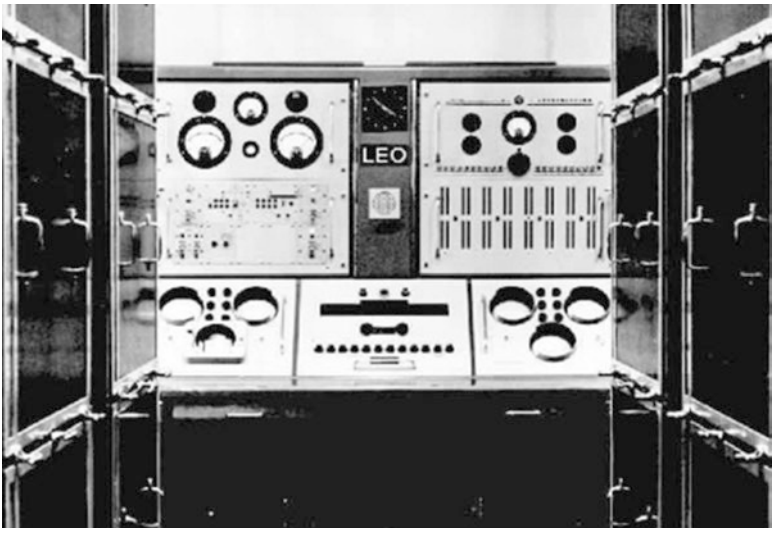

Fig. 5.2 LEO I computer. (Courtesy of LEO Computer Society)

5.4 The Z4 Computer

Zuse KG was founded by Konrad Zuse at Neukirchen (north of Frankfurt) in 1949. It was the first computer company in Germany and it initially had five employees. The early focus of the company was to restore and improve Zuse's Z4 machine, which had survived the Allied bombing of Berlin, and Zuse's subsequent move to Bavaria.

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The Z4 machine (Fig. 5.3) consisted of 2200 relays (electrically operated switches), a mechanical memory of sixty-four 32-bit words, and a processor. The speed of the machine was approximately 1000 instructions per hour (and so it was very slow compared to the other early digital computers). The Henschel Aircraft Company had ordered the Z4 machine in 1942, but as the production of the machine was time consuming, it was never actually delivered to Henschel. The machine was almost completed by the end of the Second World War in 1945.

The Z4 was restored for the Institute of Applied Mathematics at the Eidgenössische Technische Hochschule Zürich (ETH) in Zurich. The restoration was complete in 1950, and it was delivered to the ETH later that year. It was one of the first operational computers in Europe at that time.

It was transferred to the French-German Research Institute of Saint-Louis in France in 1955, and it remained operational there until 1959. Today, the Z4 machine is on display at the Deutsche Museum in Munich.

Fig. 5.3 The Z4 computer. (Creative Commons)

Zuse ZG commenced work on the Z5 in the early 1950s, and this was an extended version of the Z4. The Z5 was one of the first commercial computers in Europe, and it was produced for the Leitz company in Germany. The Z5 followed similar construction principles as the Z4, but it was over six times faster.

Zuse KG produced over two hundred and fifty computers from 1949 to 1969, and by 1964 it had over 1200 employees. The company ran into financial difficulties in the early 1960s, and it was taken over by Rheinstahl in 1964. Rheinstahl was taken over by Siemens in 1967, and Konrad Zuse left the company in 1969. For a more detailed account of Zuse, see [ORg:15].

5.5 Ferranti Mark I

Ferranti Ltd. (a British company) and Manchester University collaborated to build one of the earliest general-purpose electronic computers. The machine was called the Ferranti Mark 1 (it was also known as the Manchester Electronic Computer), and it was basically an improved version of the Manchester Mark 1.

The first machine off the production line was delivered to the University of Manchester in 1951 and shortly before the release of the UNIVAC I electronic computer in the United States.

The main improvements of the Ferranti Mark 1 over the Manchester Mark I computer were in the size of primary and secondary storage, a faster multiplier, and additional instructions. The Ferranti Mark I (Fig. 5.4) had 8 pages of random access memory (i.e., 8 Williams tubes each with a storage capacity of sixty-four 20-bit words or 1280 bits). A 512-page magnetic drum, which stored two pages per track, provided the secondary storage, and its revolution time was 30 milliseconds.

It used a 20-bit word stored as a single line of dots on the Williams tube display, with each tube storing a total of 64 lines of dots (or 64 words). Instructions were stored in a single word, while numbers were stored in two words.

The accumulator was 80 bits and it could also be addressed as two 40-bit words. There were about 50 instructions and the standard instruction time was 1.2 milliseconds. Multiplication could be completed in 2.16 milliseconds. There were 4050 vacuum tubes employed.

The Ferranti Mark 1's instruction set included a "hoot command," which allowed auditory sounds to be produced. It also allowed variations in pitch. Christopher Strachey (who later did important work in the semantics of programming languages) programmed the Ferranti Mark 1 to play tunes such as "God save the King," and the Ferranti Mark 1 was one of the earliest computers to play music.

Dr. Dietrich Prinz wrote one of the earliest computer games (a chess-playing program) for the Ferranti Mark I in 1951. The parents of Tim Berners-Lee (the inventor of the world-wide web) both worked on the Ferranti Mark 1.

Fig. 5.4 Ferranti Mark I

5.6 CSIRAC Computer

The CSIRAC (Council for Scientific and Industrial Research Automatic Computer) was Australia's first digital computer. It was one of the earliest stored program computers, and it became operational in November 1949. It is on permanent display at the Melbourne Museum.

It was constructed by a team led by Trevor Pearcey and Maston Beard at the CSIR in Sydney. The machine had 2,000 vacuum valves and used 30kW of power during operation. The input to the machine was done with a punched paper tape, and output was to a teleprinter or to punched tape. The machine was controlled through a console, which allowed programs to be stepped through one at a time.

The CSIRAC (Fig. 5.5) was the first digital computer to play music and this took place in 1950. The machine was moved to the University of Melbourne in the mid-1950s, and today the machine is on permanent display at the Melbourne Museum.

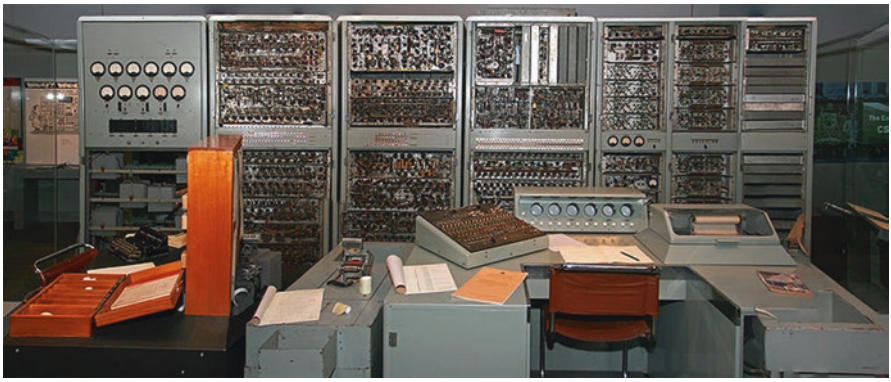

Fig. 5.5 CSIRAC computer. (Creative Commons)

5.7 Review Questions

1. What are the key contributions made by EMCC/Unisys to the computing field?
2. Describe the contributions of J, Lyons and Co. to the early computing field?
3. What is the significance of Zuse's Z4 machine?
4. Discuss the progress made in the production of music on early computers.
5. Describe the contribution of the University of Manchester to early computing. What were the key improvements in the Ferranti Mark I over the Manchester Mark I?
6. Describe the contributions of Grace Murray Hopper to the computing field.

5.8 Summary

This chapter considered a selection of the first commercial computers designed and developed in the United States, Britain, Germany, and Australia. These machines built upon the work done on the first digital computers developed during the Second World War.

We discussed the UNIVAC I computer developed by EMCC in the United States; the LEO I computer developed by J. Lyons and Co. in England; the Z4 computer developed by Zuse KG in Germany; the Ferranti Mark I developed by Ferranti in England; and CSIRAC developed by CSIR in Australia.

Mauchly and Eckert wished to commercialize their work on the ENIAC/EDVAC computers and to protect their intellectual property. The University of Pennsylvania

had introduced new policies that required them to sign over the intellectual property rights to their invention, and so they set up EMCC to commercialize their inventions.

The LEO I computer arose as a result of forward thinking by J. Lyons and Co. who wished to improve their businesses processes, and they collaborated with Maurice Wilkes at Cambridge University to produce the LEO I computer.

The UK government encouraged Ferranti to commercialize the Manchester Mark I computer, and the Ferranti Mark I was an improved version, which was commercialized in the UK.