A Brief History of the Computer

by John Dixon

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Preface

Ever since the abacus was invented thousands of years ago, the human race has been using devices to help with computation, but it wasn't until the mechanical calculator was invented by Wilhelm Schickard in 1623 that the era of the computer truly began. His invention – the calculating clock – used cogs and gears and was a long way away from where we are today with our mobile phones, tablets and laptops, but it did signify a significant development in the use of calculating devices, and mechanical calculators were used well into the 20th century. In fact, the slide rule, which is a type of mechanical calculator, is still used today by some engineers, even though it was invented way back in the 1620s by William Oughtred.

The invention of the punched card in 1801 was another significant milestone in the history of the computer. In 1801, Joseph-Marie Jacquard developed a loom in which punched cards controlled the pattern being woven. The series of cards could be changed without changing the mechanical design of the loom ... this was a landmark point in programmability.

The defining feature of a computer is the ability to program it, and programmable machines gradually became more widespread from about 1835 onwards. A program enables a computer to emulate different calculating machines by using different stored sequences of instructions. In 1837, Charles Babbage described his Analytical Engine, which was a general purpose programmable computer that used punched cards for input and a steam engine for power. Babbage never built his Analytical Engine, but a model of part of it is on display at the Science Museum in London, UK.

Electronic calculators didn't appear until the 1960s, with the Sumlock Comptometer Anita C/VIII quite possibly being the first. Its price tag though was a hefty $2200. Electrical digital computers themselves were invented in the 1940s, with the onset of the Second World War causing great advances to be made in computer design and development. Electronic circuits, relays, capacitors and vacuum tubes replaced their mechanical equivalents, and digital calculations replaced analog ones.

The next major step in the history of the computer was the invention of the transistor in 1947, which replaced the fragile and power-hungry valves with a much smaller and reliable component. This was the beginning of miniaturization. Through the 1950s and 60s computers became more widespread, and in 1959 IBM started selling the transistor-based IBM 1401. In total, 12000 were shipped, making it the most successful computer of that period.

The explosion in computers really began with the invention of the integrated circuit (or microchip), which led to the invention of the microprocessor at Intel. The microprocessor led, in turn, to the development of the microcomputer. Microcomputers were affordable to small businesses and individuals alike, and continued the unstoppable technological march that has brought us to where we are today.

About this Book

This book will take you on a nostalgic journey as we look back at the people, computers, programming languages and games that have forged the history of the computer.

The YouTube Channel

Any videos that accompany this book are available on our YouTube channel, which you can find here:

https://www.youtube.com/channel/UChoBHeUk6tc6Si2hrdOYJOw

Who this Book is for

This book is for anyone who is interested in learning about the history of the computer. The book isn't exhaustive, but it should give you a taster that will hopefully encourage you to carry out more research on the history of the computer should you wish to do so.

Quick Start Workbooks

You can find information about other books written by John Dixon at the Quick Start Workbook website:

http://www.quickstartworkbook.com

How this Book is Organised

Each chapter in this book looks at a major area of the history of the computer, beginning the computer itself, we then move on to look at programming languages, the microprocessor, operating systems, and computer games.

Chapter 1 - The Computer

Computing hardware has been an essential component of the process of calculation and data storage since it became useful for numerical values to be processed and shared. The earliest computing hardware was probably some form of tally stick. In this chapter we'll take a look at some of the most significant advances that have been made in the world of computing over the past few hundred years.

Chapter 2 - Programming Languages

This article discusses the major developments in the history of programming languages.

The first programming languages predate the modern computer. Herman Hollerith realized that he could encode information on punch cards when he observed that railroad train conductors would encode the appearance of the ticket holders on the train tickets using the position of punched holes on the tickets.

Chapter 3 – The Microprocessor

A microprocessor (sometimes abbreviated µP) is a digital electronic component with transistors on a single semiconductor integrated circuit (IC). One or more microprocessors typically serve as a central processing unit (CPU) in a computer system or handheld device. Microprocessors made possible the advent of the microcomputer.

Chapter 4 – Operating Systems

A computer's operating system (OS) provides a set of functions needed and used by most applications, and provides the necessary linkages to control a computer's hardware. On the first computers, without an operating system, each program would need its own drivers for the video card, memory card, and other peripherals. The evolution of computer applications and their complexity led to the OS necessities.

Chapter 5 – Computer Games

Although the history of computer and video games spans five decades, computer and video games themselves did not become part of the popular culture until the late 1970s. Over the past three or four decades, video games have become extremely popular, either in the form of hand held consoles, or with games that run on computers or attached to TVs. The range of games available is also immense, with action, strategy, adventure, and sports games being very popular. In this chapter we will look at how computer and other video games have evolved since the 1960s.

About Me

My name is John Dixon and I have been working as a Technical Author for the past 30 years. During this time I have written numerous manuals about software applications, operating systems, and computer hardware.

I love writing and I enjoy designing and developing websites, which is something I have been doing since 1997 when I produced my first website whilst working at Hewlett-Packard in Grenoble, France. Since then I have designed and built sites for large companies such as IBM, as well as many small companies.

I began my working career as an engineering apprentice in 1979. This almost seems like the dark ages now, and I remember that at my first company we had one desktop computer for the whole firm ... and there were over 1100 of us! Apart from using a mini computer at college, my first experience of computing wasn't until the mid-eighties when I was working at an electronics company, which incidentally is where I began my technical authoring career. I don't think anyone then could have imagined where the computer industry would be today.

My LinkedIn address is shown below. I'd be pleased to hear from you if you have any comments on this book – good or bad – or if you just want to connect with me.

uk.linkedin.com/pub/john-dixon/1/648/a52

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Chapter 1

The Computer

Computing hardware has been an essential component of the process of calculation and data storage since it became useful for numerical values to be processed and shared. The earliest computing hardware was probably some form of tally stick; later recording devices include the Phoenician clay shapes which represented quantities or 'counts' of items, probably livestock or grains, in containers. These seem to have been used by the merchants, accountants, and government officials of the time.

Devices to aid computation have evolved from simple recording and counting devices through the abacus, the slide rule, early electronic computers to the sophisticated mobile computing devices we have today. However, it's interesting that even today, an experienced abacus user using a device designed hundreds of years ago can sometimes complete basic calculations more quickly than an unskilled person using an electronic calculator - though for more complex calculations, computers can easily out-perform even the most skilled human.

In the Beginning...

Humanity has used devices to aid in computation for millennia. One example is a device for establishing equality by weight: the classic scales, later used to symbolize equality in justice. Another is simple enumeration: the checkered cloths of the counting houses served as simple data structures for enumerating stacks of coins, by weight. A more arithmetic-oriented machine is the abacus. One of the earliest machines of this type was the Chinese abacus, which was invented about 5000 years ago.

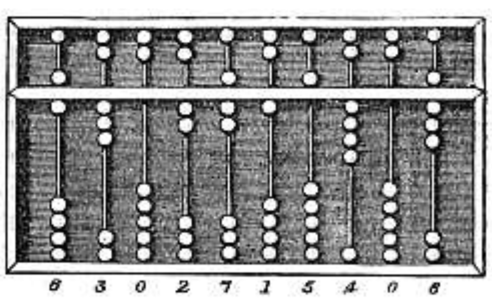

Figure 1-1 - The Chinese Abacus

The First Mechanical Calculators

In 1623 Wilhelm Schickard built the first mechanical calculator and thus became the father of the computing era.

Figure 1-2 – Wilhelm Schickard and a replica of his calculating machine

Since his machine used techniques such as cogs and gears that were first developed for clocks, it was also called a 'calculating clock'. It was put to practical use by his friend, the astronomer Johannes Kepler.

Machines by Blaise Pascal (the Pascaline, 1642) and Gottfried Wilhelm von Leibniz (1671) followed. Around 1820, Charles Xavier Thomas created the first successful, mass-produced mechanical calculator, the Thomas Arithmometer, that could add, subtract, multiply, and divide. It was mainly based on Leibniz's work. Mechanical calculators, like the base-ten addiator, the comptometer, the Monroe, the Curta and the Addo-X remained in use until the 1970s.

Leibniz also described the binary numeral system, which is a central ingredient of all modern computers. However, up to the 1940s, many subsequent designs (including Charles Babbage's machines of the 1800s and even ENIAC of 1945) were based on the harder-to-implement decimal system.

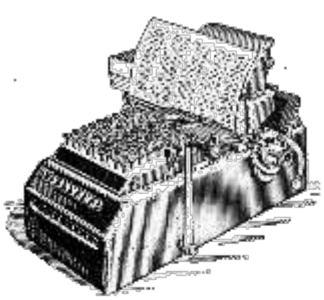

Figure 1-3 - A mechanical calculator from 1914

Napier's Bones

John Napier (1550-1617) - a Scottish mathematician, physicist, and astronomer - noted that multiplication and division of numbers can be performed by addition and subtraction, respectively, of logarithms of those numbers. While producing the first logarithmic tables Napier needed to perform many multiplications, and it was at this point that he designed Napier's bones.

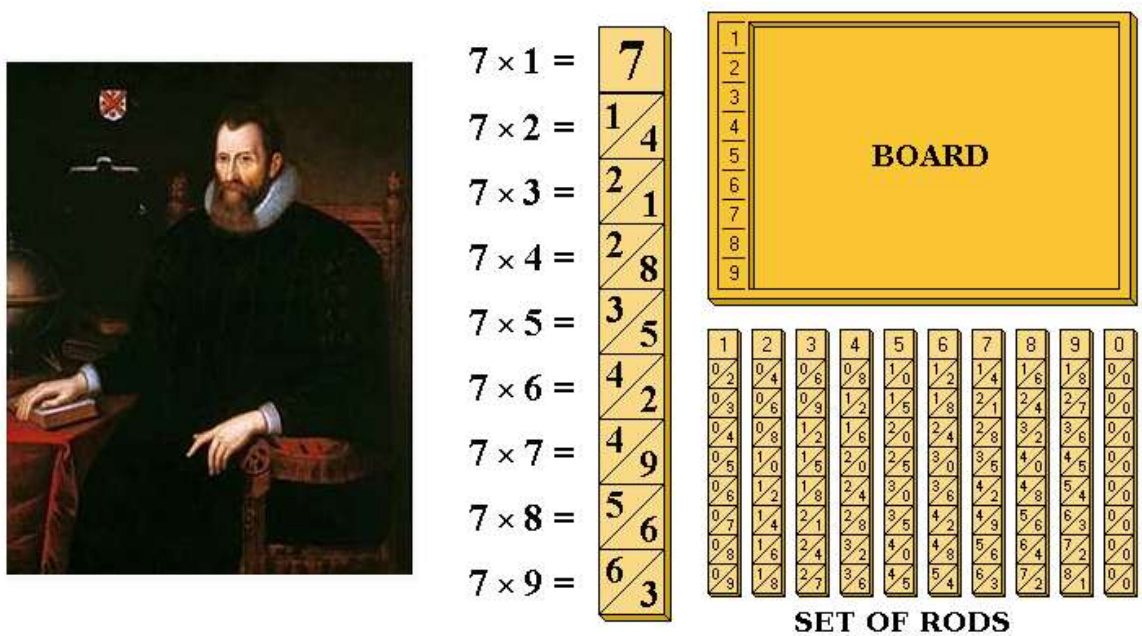

Figure 1-4 – John Napier and Napier's Bones

Napier's bones provide a mechanical method for performing multiplication and division, based upon manipulation of rods with printed digits. They became a very popular calculating device because most people lacked these mathematical skills.

The Slide Rule

The slide rule, invented by William Oughtred in the 1620s, allowed multiplication and division operations to be carried significantly faster than was previously possible. Slide rules were used by generations of engineers and other mathematically inclined professional workers until the invention of the pocket calculator. The engineers in the Apollo program to send a man to the moon made many of their calculations on slide rules, which were accurate to 3 or 4 significant figures.

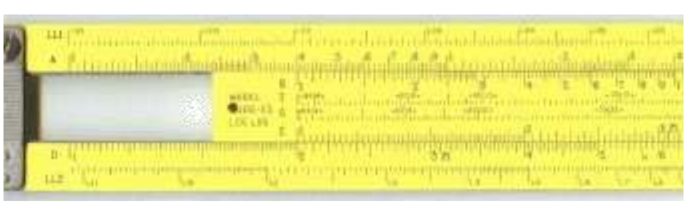

Figure 1-5 - The slide rule, a basic mechanical calculator, facilitates multiplication and division

Punched Card Technology (1801)

In 1801, Joseph-Marie Jacquard developed a loom in which the pattern being woven was controlled by punched cards. The series of cards could be changed without changing the mechanical design of the loom. This was a landmark point in programmability.

In 1833, Charles Babbage moved on from developing his difference engine to developing a more complete design, the analytical engine which would draw directly on Jacquard's punch cards for its programming.

In 1890, the United States Census Bureau used punch cards and sorting machines designed by Herman Hollerith to handle the flood of data from the decennial census mandated by the Constitution. Hollerith's company eventually became the core of IBM. IBM developed punch card technology into a powerful tool for business data processing and produced an extensive line of specialized unit record equipment. By 1950 the IBM card had become ubiquitous in industry and government. The warning printed on most cards, "Do not fold, spindle or mutilate", became a motto for the post-World War II era.

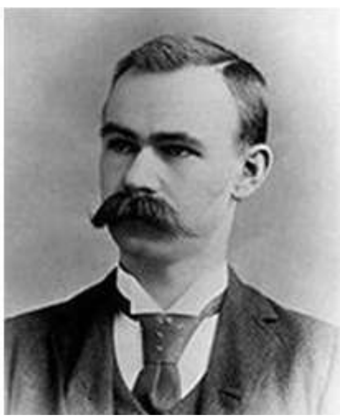


Figure 1-6 - Herman Hollerith invented a tabulating machine using punch cards in the 1880s

The tabulating machine was an electromechanical machine designed to assist in summarizing information and, later, accounting.

Leslie Comrie's articles on punch card methods and W.J. Eckert's publication of Punched Card Methods in Scientific Computation in 1940, described techniques which were sufficiently advanced to solve differential equations, perform multiplication and division using floating point representations, all on punched cards and plug-boards similar to those used by telephone operators. The Thomas J. Watson Astronomical Computing Bureau, Columbia University performed astronomical calculations representing the state of the art in computing.

In many computer installations, punched cards were used until (and after) the end of the 1970s. For example, science and engineering students at many universities around the world would submit their programming assignments to the local computer centre in the form of a stack of cards, one card per program line, and then had to wait for the program to be queued for processing, compiled, and executed. In due course a printout of any results, marked with the submitter's identification, would be placed in an output tray outside the computer center. In many cases these results would comprise solely a printout of error messages regarding program syntax etc., necessitating another edit-compile-run cycle.

Punched cards are still used and manufactured in the current century, and their distinctive dimensions (and 80-column capacity) can still be recognised in forms, records, and programs around the world.

The First Programmable Machines (1835-1900)

The defining feature of a "universal computer" is programmability, which allows the computer to emulate any other calculating machine by changing a stored sequence of instructions.

In 1837, Charles Babbage described his analytical engine. It was the plan of a general-purpose programmable computer, employing punch cards for input and a steam engine for power. One crucial invention was to use gears for the function served by the beads of an abacus. In a real sense, computers all contain automatic abacuses (technically called the ALU or floating-point unit).


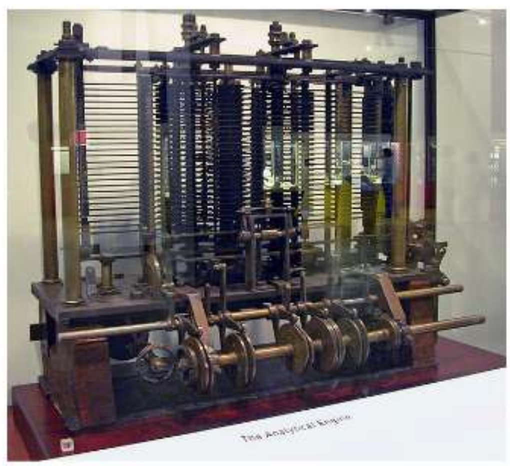

Figure 1-7 - Charles Babbage and a model of part of the Analytical Engine, as displayed at the Science Museum (London)

Babbage's initial idea was to use punch-cards to control a machine that could calculate and print logarithmic tables with huge precision (a specific purpose machine). His idea soon developed into a general-purpose programmable computer, his analytical engine.

While his design was sound and the plans were probably correct, or at least debuggable, the project was slowed by various problems. Babbage was a difficult man to work with and argued with anyone who didn't respect his ideas. All the parts for his machine had to be made by hand and small errors in each item were summed up as huge discrepancies in a machine with thousands of parts. The project dissolved over disputes with the artisan who built parts and was ended with the depletion of government funding.

Ada Lovelace, Lord Byron's daughter, translated and added notes to the "Sketch of the Analytical Engine" by Federico Luigi, Conte Menabrea. She has become closely associated with Babbage. Some claim she is the world's first computer programmer, however this claim and the value of her other contributions are disputed by many.

Figure 1-8 - Augusta Ada King, Countess of Lovelace

A reconstruction of the Difference Engine II, an earlier, more limited design, has been operational since 1991 at the London Science Museum. With a few trivial changes, it works as Babbage designed it and shows that Babbage was right in theory.

The museum used computer-operated machine tools to construct the necessary parts, following tolerances which a machinist of the period would have been able to achieve. Some feel that the technology of the time was unable to produce parts of sufficient precision, though this appears to be false.

The failure of Babbage to complete the engine can be chiefly attributed to difficulties not only related to politics, but also his desire to develop an increasingly sophisticated computer. Personal finance failing and an overly ambitious attitude for his time, eventually led to his failure. Today, many in the computer field term this sort of obsession creeping featuritis. Babbage may have been able to finance this project better if he had been able to work with people better, and with better leadership and management skills the government may well have been more inclined to continue their financial contributions.

Following in the footsteps of Babbage, although unaware of his earlier work, was Percy Ludgate, an accountant from Dublin, Ireland. He independently designed a programmable mechanical computer, which he described in a work that was published in 1909.

Desktop Calculators (1930s-1960s)

By the 1900s, earlier mechanical calculators, cash registers, accounting machines, and so on were redesigned to use electric motors, with gear position as the representation for the state of a variable. Companies like Friden, Marchant and Monroe made desktop mechanical calculators from the 1930s that could add, subtract, multiply and divide. The word "computer" was a job title assigned to people who used these calculators to perform mathematical calculations. During the Manhattan project, future Nobel laureate Richard Feynman was the supervisor of the roomful of human computers, many of them women mathematicians, who understood the differential equations which were being solved for the war effort. Even the renowned Stanislaw Marcin Ulam was pressed into service to translate the mathematics into computable approximations for the hydrogen bomb, after the war.

In 1948, the Curta was introduced. This was a small, portable, mechanical calculator that was about the size of a pepper grinder. Over time, during the 1950s and 1960s, a variety of different brands of mechanical calculator appeared on the market.

Figure 1-9 – Curta Mechanical Calculator

The first desktop electronic calculator was probably Sumlock Comptometer's 1961 Anita C/VIII, which used a Nixie tube display and 177 subminiature thyratron tubes. In June 1963, Friden introduced the four-function EC-130. It had an all-transistor design, 13-digit capacity on a 5-inch CRT, and introduced reverse Polish notation (RPN) to the calculator market at a price of $2200.

Figure 1-10 - Sumlock Comptometer's 1961 Anita C/VIII Electronic Calculator

The acronym 'ANITA' was officially proclaimed to be derived from, variously, **A** **N**ew **I**nspiration **T**o **A**rithmetic, or **A** **N**ew **I**nspiration **T**o **A**ccounting, though there have been rumours that this was also the name of the designer's wife.

The model EC-132 added square root and reciprocal functions. In 1965, Wang Laboratories produced the LOCI-2, a 10-digit transistorized desktop calculator that used a Nixie tube display and could compute logarithms.

With development of the integrated circuits and microprocessors, the expensive, large calculators were replaced with smaller electronic devices.

The Arrival of the Electrical Digital Computer (1940s)

The era of modern computing began with a flurry of development before and during World War II, as electronic circuits, relays, capacitors and vacuum tubes replaced mechanical equivalents and digital calculations replaced analog calculations. The computers designed and constructed during this period have sometimes been called 'first generation' computers.

First generation computers such as the Atanasoff-Berry Computer, Z3 and Colossus were built by hand, using circuits containing relays or vacuum valves (tubes), and often used punched cards or punched paper tape for input and as the main (non-volatile) storage medium. Temporary, or working storage, was provided by acoustic delay lines (which use the propagation time of sound in a medium such as wire to store data) or by Williams tubes (which use the ability of a television picture tube to store and retrieve data). By 1954, magnetic core memory was rapidly displacing most other forms of temporary storage, and dominated the field through the mid-1970s.

In this era, a number of different machines were produced with steadily advancing capabilities. At the beginning of this period, nothing remotely resembling a modern computer existed, except in the long-lost plans of Charles Babbage and the mathematical musings of Alan Turing and others. At the end of the era, devices like the EDSAC had been built, and are universally agreed to be digital computers.

Alan Turing's 1936 paper has proved enormously influential in computing and computer science in two ways. Its main purpose was an elegant proof that there were problems (namely the halting problem) that could not be solved by a mechanical process (a computer). In doing so, however, Turing provided a definition of what a universal computer is: a construct called the Turing machine, a purely theoretical device invented to formalize the notion of algorithm execution, replacing Kurt Gödel's more cumbersome universal language based on arithmetic. Modern computers are Turing-complete (i.e., equivalent algorithm execution capability to a universal Turing machine), except for their finite memory. This limited type of Turing completeness is sometimes viewed as a threshold capability separating general-purpose computers from their special-purpose predecessors.

Turing-Complete (taken from Wikipedia)

Turing completeness, named after Alan Turing, is significant in that every plausible design for a computing device so far advanced can be emulated by a universal Turing machine — an observation that has become known as the Church-Turing thesis. Thus, a machine that can act as a universal Turing machine can, in principle, perform any calculation that any other programmable computer is capable of. However, this has nothing to do with the effort required to write a program for the machine, the time it may take for the machine to perform the calculation, or any abilities the machine may possess that are unrelated to computation.

While truly Turing-complete machines are very likely physically impossible, as they require unlimited storage, Turing completeness is often loosely attributed to physical machines or programming languages that would be universal if they had unlimited storage. All modern computers are Turing-complete in this sense.

However, theoretical Turing-completeness is a long way from a practical universal computing device. To be a practical general-purpose computer, there must be some convenient way to input new programs into the computer, such as punched tape. For full versatility, the Von Neumann architecture uses the same memory both to store programs and data; virtually all contemporary computers use this architecture (or some variant). Finally, while it is theoretically possible to implement a full computer entirely mechanically (as Babbage's design showed), electronics made possible the speed and later the miniaturization that characterises modern computers.

There were three parallel streams of computer development in the World War II era, and two were either largely ignored or were deliberately kept secret. The first was the German work of