

HISTORY AND EVALUATION OF COMPUTERS

2.1 A Brief History and Evaluation of Computers

History of computers dates back to the 1800s with English mathematician Charles Babbage inventing different machines for automatic calculations. However, history of computing dates back to as ancient as 2,700 BC. While the development and use of **Abacus** around 2700 BC in different world civilizations marked the beginning of computing, innovations such as the **Jacquard Loom** (1805) and **Charles Babbage's "Analytical Engine"** (1834) signified the new age continuation of this development.

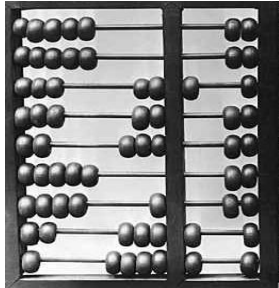
The modern history of computers primarily comprises the development of mechanical, analog and digital computing architectures. During the early days of electronic computing devices, there was much discussion about the relative merits of Analog vs. Digital computers. While Analog Computers use the continuously changeable aspects of physical phenomena such as electrical, mechanical, or hydraulic quantities to model the problem that is being solved, Digital Computers use varying quantities symbolically with their numerical values changing.

As late as the 1960s, mechanical devices, such as the **Merchant Calculator** have widespread application in science and engineering. Until this period, analog computers were routinely used to solve systems of finite difference equations arising. However, in the end, digital computing devices proved to have the power, economics and scalability that were necessary to deal with large scale computations, and found universal acceptance.

Digital computers now dominate the computing world in all areas ranging from the hand calculator to the super computer and are pervasive throughout society.

Therefore, this brief sketch of the development of scientific computing is limited to the area of digital, electronic computers.

2.2 The Mechanical Era (1623 - 1945)



Indeed, the history and evolution of computers is quite extraordinary. The history of computers can be traced back to 2700 BC in different civilizations such as Sumerian, Roman and Chinese, which made use of Abacus for mathematical calculations. **Abacus**, a wooden rack holding two horizontal wires with beads strung on them. Numbers are represented using the position of beads on the rack.

Fast and simple calculations can be carried out by appropriately placing the beads.

In 1620, an English mathematician by the name *William Oughtred* invented the slide rule – a calculating device based on the principle of logarithms. It consisted of two graduated scales devised in such a manner that suitable alignment of one scale against the other, made it possible to perform additions, compute products etc. just by inspection.

Blaise Pascal, a French mathematician, is usually credited for building the first digital computer in 1642. He invented the mechanical calculating machine. Numbers were entered in this machine by dialing a series of numbered wheels. Another series of toothed wheels transferred the movements to a dial, which showed the results.

In 1671, *Gottfried von Leibnitz*, a German mathematician, invented a calculating machine which was able to add and perform multiplications. He invented a special **stepped gear** mechanism for introducing the addend digits, which is still being used.

It was only about a century later that *Thomas of Colmar* created the first successful mechanical calculator which could add, subtract, multiply, and divide. A lot of improved desktop calculators by various inventors followed, such that by 1890 a

range of improvements like accumulation of partial results, storage of past results, and printing of results were taking place.

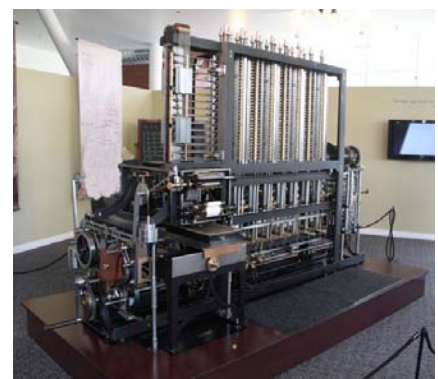
2.3 The First Computer

Charles Babbage, a professor of mathematics at **Cambridge University**, England, realized that many long calculations usually consisted of a series of actions that were constantly repeated and hence could possibly be automated. By 1822, he designed an automatic calculating machine that he called the '**Difference Engine**'. It was intended to be steam powered and fully automatic (including printing of result tables), commanded by a fixed instruction program. In short, he developed a prototype of a computer which was 100 years ahead of time and is, therefore, considered as the **Father of modern day computers**.

The idea of using machines to solve mathematical problems can be traced at least as far as the early 17th century. Mathematicians who designed and implemented calculators that were capable of addition, subtraction, multiplication, and division included **Wilhelm Schickard**, **Blaise Pascal** and **Gottfried Leibnitz**.

The first multi-purpose, i.e. *programmable* computing device was probably **Charles Babbage's Difference Engine**, which was begun in 1823 but never completed. A more ambitious machine was the **Analytical Engine** was designed in 1842, but unfortunately it also was only partially completed by Babbage. Babbage was truly a man ahead of his time: many historians think the major reason he was unable to complete these projects was the fact that the technology of the day was not reliable enough.

The first computers were designed by **Charles Babbage** in the mid-1800s, and are sometimes collectively known



as the **Babbage Engines**. The **Difference Engine** was constructed from designs by Charles Babbage. These early computers were never completed during Babbage's lifetime, but their complete designs were preserved. Eventually, one was built in 2002.

A step towards automated computing was the development of punched cards which were first successfully used by *Herman Hollerith* in 1890. He along with *James Powers* developed devices that could read information that had been punched into cards, without any human help. This resulted in reduced reading errors, increased workflow and availability of unlimited memory.

These advantages were seen by various commercial companies and soon led to the development of improved **punch-card** using computers by companies like **International Business Machines (IBM)** and **Remington**.

2.4 Some Well Known First Generation Computers

Mark I

After **World War II** there was a need for advanced calculations. *Howard A. Aiken* of **Harvard University**, while working on his doctorate in physics designed a machine that could automatically perform a sequence of arithmetic operations in 1937. He completed this in 1944 and named it **Mark I**. This machine performed a multiplication and division at an average of about four and eleven seconds respectively. The results were printed at a rate of one result per five seconds.

ENIAC

The World War II also produced a large need for computer capacity especially for the military. New weapons were made for which calculating tables and other essential data were needed. In 1942, Professors *John P. Eckert* and *John W. Mauchly* at the **Moore School of Engineering** of the



Replacing a bad tube means checking among ENIAC's 15000 possibilities.

University of Pennsylvania, USA, decided to build a high speed computer to do the job. This was called the **Electronic Numeric Integrator and Calculator (ENIAC)**.

It used 18,000 **vacuum tubes**; about 1,800 square feet of floor space, and consumed about 180,000 watts of electrical power. It had punched cards **I/O** and its programs were wired on boards.

ENIAC is accepted as the first successful high-speed electronic digital computer and was used from 1946 to 1955.

EDVAC

Fascinated by the success of **ENIAC**, *John Von Neumann*, a mathematician, undertook an abstract study of computation in 1945. In this he aimed to show that a computer should be able to execute any kind of computation by means of a proper programmed control. His ideas, referred to as '**stored program technique**', became essential for future generations of high-speed digital computers and were universally accepted. The basic idea behind the stored program concept was that data as well as instructions can be stored in the computer's memory to enable automatic flow of operations.

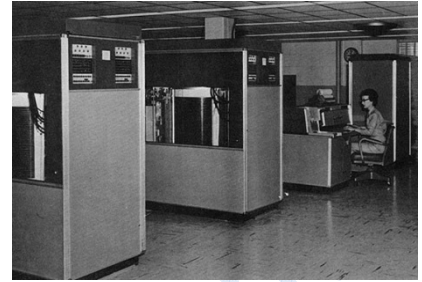
Between 1947 and 1950, the **More School** personnel and the **Ballistics Research Laboratory** of the **US Army** built a computer named **Electronic Discrete Variable Automatic Computer (EDVAC)**, which was based on **Von Neumann's** concept of stored program.

UNIVAC

The **Universal Automatic Computer (UNIVAC)**, developed in 1951, was the first digital computer to be produced and was installed in the **Census Bureau**. The first generation stored-program computers needed a lot of maintenance. **EDVAC** and **UNIVAC** fell into this group of computers and were the first commercially available computers.

Mid-1950s: Transistor Computers (Second Generation)

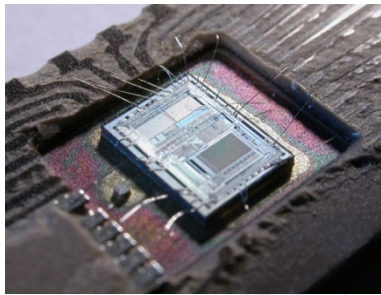
The development of **transistors** led to the replacement of vacuum tubes, and resulted in significantly smaller computers. In the beginning, they were less reliable than the **vacuum tubes** they replaced, but they also consumed significantly less power. **IBM 350 RAMAC** used disk drives.



These transistors also led to developments in **computer peripherals**. The first disk drive, the **IBM 350 RAMAC**, was the first of these introduced in 1956.

1960s: The Microchip and the Microprocessor (Third Generation Computers)

The microchip (or integrated circuit) is one of the most important advances in computing technology. Many overlaps in history existed between microchip-based



computers and transistor-based computers throughout the 1960s. **Microchips** allowed the manufacturing of smaller computers. The microchip spurred the production of minicomputers and microcomputers, which were small and inexpensive enough for small businesses and even individuals to own. The microchip also led to the microprocessor, another breakthrough technology that was important in the development of the personal computer.

The first processors were 4-bit, but 8-bit models quickly followed by 1972. 16-bit models were produced in 1973, and 32-bit models soon followed. AT&T Bell Labs created the first fully 32-bit single-chip microprocessor, which used 32-bit buses, 32-bit data paths, and 32-bit addresses, in 1980. The first 64-bit microprocessors were in

use in the early 1990s in some markets, though they didn't appear in the PC market until the early 2000s.

1970s: Personal Computers (Fourth Generation)

The first personal computers were built in the early 1970s. Most of these were runs, and worked based on small-scale integrated circuits and multi-chip CPUs.

The **Commodore PET** was a personal computer in the 70s. The Altair 8800 was the first popular computer using a single-chip microprocessor. Clones of this machine quickly cropped up, and soon there was an entire market based on the design and architecture of the 8800. It also spawned a club based around hobbyist computer builders, the **Homebrew Computer Club**. 1977 saw the rise of the "Trinity" the **Commodore PET**, the **Apple II**, and the **Tandy Corporation's TRS-80**. These three computer models eventually went on to sell millions.



These early PCs had between 4kB and 48kB of **RAM**. The Apple II was the only one with a full-color, graphics-capable display, and eventually became the best-seller among the trinity, with more than 4 million units sold.

1980s-1990s: The Early Notebooks and Laptops



One particularly notable development in the 1980s was the advent of the commercially available portable computer. **Osborne 1** was small and portable enough to transport.

The first of these was the **Osborne 1**, in 1981. It had a tiny 5" monitor and was large and heavy compared to modern laptops (weighing in at 23.5 pounds). Portable computers continued to develop, though, and eventually



became streamlined and easily portable, as the notebooks we have today are. These early portable computers were portable only in the most technical sense of the word. Generally, they were anywhere from the size of a large electric typewriter to the size of a suitcase. The **Gavilan SC** was the first PC to be sold as a "laptop".

The **first laptop with a flip form factor** was produced in 1982, but the first portable computer that was actually marketed as a "laptop" was the **Gavilan SC** in 1983.

Early models had monochrome displays, though there were color displays available starting in 1984 (the **Commodore SX-64**). Laptops grew in popularity as they became smaller and lighter.

2000s: The Rise of Mobile Computing (Present and Beyond)

Mobile computing is one of the most recent major milestones in the history of computers. Many smartphones today have higher processor speeds and more memory than desktop **PCs** had even ten years ago.



With phones like the **iPhone** and the **Motorola Droid**, it's becoming possible to perform most of the functions once reserved for desktop **PCs** from anywhere. The **Droid** is a smartphone capable of basic computing tasks such as emailing and web browsing.

Mobile computing really had its start in the 1980s with the pocket **PCs** of the era. These were something like a cross between a calculator, a small home computer and a **PDA**. During the 1990s, **PDA**s (**Personal Digital Assistant**) became popular.

A number of manufacturers had models, including **Apple** and **Palm**. The main feature **PDA**s had that not all pocket **PCs** had was a touch screen interface. Most basic computing functions can now be done on a smartphone, such as email, browsing the internet, and uploading photos and videos.

Late 2000s: Netbooks (Artificial Intelligence)

Another recent progression in computing history is the development of **netbook** computers. **Netbooks** are smaller and more portable than standard **laptops**. Some netbooks go as far as to have not only built-in **Wi-Fi** capabilities, but also built-in mobile broadband connectivity options.

The **Asus Eee PC 700** was the first netbook to enter mass production. The first mass-produced netbook was the Asus Eee PC 700, released in 2007. They were originally released in Asia, but were released in the US not long afterward. Other manufacturers quickly followed suit, releasing additional models throughout 2008 and 2009.



Some of the milestones of Computers Until 1960

3000 B.C.

Abacus is over 5000 years old. Earliest form of this device is made of wooden table which was sprinkled with sand. Later beads were used to make calculations. This instrument is still utilized in many parts of the world.

1617

John Napier creates a mechanical numbering device which evolved into the logarithmic scale-based slide rule.

1623

The first mechanical calculator is invented by **Wilhelm Schickard**. The records of this invention were lost in the Thirty Year' War.

1642

An adding machine is developed by the **French scientist, Blaise Pascal**. This machine was a digital device with the numbers 0-9, once the sum reached the decimal place the wheel rolled over to the next column. This machine was used to calculate the exchange rate of national currencies.

1674

Gottfried Wilhelm Leibniz expands on **Pascal's** discovery and produces a machine that can add, subtract, multiply, and divide.

1694

Leibniz updates this machine, which now can also perform division and multiplication.

1804

The introduction of using **punched cards** in a fully automated loom is developed by **Joseph-Marie Jacquard**. The punched cards contained the information needed for controlling data processing in a machine.

1820

The **arithmometer** is produced by **Charles Xavier Thomas de Colmar**. This was the first commercially available calculator.

1822

Charles Babbage's prototype of the **Difference Engine** is created. This computing machine performed differential equations.

1834

Babbage is inspired to develop the **Analytical Engine** - the first digital computer. Due to a lack of funding, this project was never completed. If it had, Babbage's invention would have contained many of the basic elements found in modern computers. This includes an arithmetic unit, memory for storing numbers, a **punched card** input/output capacity and sequential control. **Augusta Ada King** was Babbage's assistant and work with him on creating instruction routines better known as computer programs.

1847

The Mathematical Analysis of Logic: Being and Essay Towards a Calculus of Deductive Reasoning is published. The author, **George Boole**, outline what is to become **Boolean algebra**. Boole treats logic as a mathematical theory. This theory uses logic operators - **AND**, **OR**, and **NOT** on binary numbers.

1889

To process the **United States Census of 1890**, **Herman Hoolerith** created an electromechanical machine that calculated the census data. This invention produced a general tally of the population in just six weeks as compared to previous tallies which had taken seven years. **Hoolerith** used punched cards to store data which he then fed into the machine to compile the results.

1894

Hollerith patents a punched card system that use pneumatic pressure instead of electricity and air tubes. This invention was never completed.

1896

The **Tabulating Machine Company** is founded by **Herman Hollerith**. This becomes the **International Business Machines (IBM)** in 1924 after numerous mergers.

1903

An employee of **Thomas Edison**, **Nikola Tesla**, patents electrical logic circuits called "gates" or "switches". In later machines, these will become crucial for addition, subtraction and multiplication.

1910

A statistical engineer of the **United States Census**, **James Powers** Designed a new type of punch card machine. This used a simultaneous punching technique which allowed the data of an entire punch card to be entered before it was physically punched. It was a ninety column card with round holes.

1914

Jay R. Monroe and **Frank S. Baldwin** develop the **Monroe** calculator.

1915

A coding machine for **encrypting** messages is invented by **Edward Heburn**.

1925-1930

At the **Massachusetts Institute of Technology (MIT)**, **Vannevar Bush** creates a calculator for solving differential equations. This is the first large scale analog computer which used mechanical parts and electric motors.

1926

An American mathematician named **Derrick Henry Lehmer** developed a computer device that could determine large prime numbers.

1928

The **cathode ray tube (CRT)** which is used for computer video displays is invented by **Vladimir Zworikin**. **L.J. Comrie** uses punched card technology to calculate the motions of the moon.

1936

"**On Computable Numbers**," a paper by **Alan Mathison Turing** is published. His theoretical computer is named the **Turing Machine**. During World War II, Turing was a member of the design team that developed a machine that would help cryptologists break the **German code**. **Konrad Zuse** requests a patent for his mechanical memory design.

1937-42

John V. Atanasoff and **Clifford E. Berry** worked on many special purpose electronic computers. A prototype was operational in 1939. This machine tested two central ideas of Atanasoff's design - electronic logic circuits to perform addition/subtraction and the use of capacitors in dynamic random-access memories.

Design work for an electromechanical computer is brought to **IBM** by **Howard Aiken**. Work on the **MARK I** automatic digital computer begins. This machine is also known as the **IBM Automatic Sequence Controlled Calculator (ASCC)**.

1938

Zuse develops the **Z1**, a computer that used a mechanical memory unit to perform binary operations.

1939

The **Complex Number Calculator**, a relay machine is built by **George Stibitz**. The Model I utilized 440 relays. The **Z2**, developed by **Konrad Zuse**, is completed.

1941

Zuse introduces the **Z3**, a machine that can convert decimal into binary and vice versa. It utilized a punch film for data entry. Most likely, this was the first computer which used program control of sequential activities.

1942

Atanasoff -Berry Computer is completed. This digital computer was capable of being 1000x more accurate than Bush's differential analyzer. The Germans used a cypher machine that used binary code to encode messages.

1943

The **Colossus**, a special-purpose computer was built at **Bletchley Park**, a British research center. It was designed to decipher codes of the Germans.

ENIAC (Electronic Numerical Integrator and Computer) project is initiated. This high-speed electronic computer was developed by **Robert Mauchly**, **J. Presper Eckart** and

other colleagues at the **University of Pennsylvania**. It contained over 18,000 vacuum tubes, programs had to be physically wired into the machine and it could execute up to 5,000 additions per minute. **ENIAC** was used to integrate ballistic equations and calculate trajectories of **Naval shells**.

Model 2 is worked on by **George Stibitz** and the **National Defense Research Committee**. It utilized paper tape and was one of the first programmable computers.

1944

Aiken's MARK I is moved to **Harvard University** for completion and renamed **Harvard MARK I**. Primarily, it was used for defense problem solving, firing tables, logistics, mathematical simulations and problems relating to atomic bombs. This was the first calculator that contained a built-in stored program.

The **Pluggable Sequence Relay Calculator (PCRC)** is produced by **IBM** for the United States Army.

1946

J.W. Forrester proposes the use of digital rather than analog computing techniques for use in the **Aircraft Stability and Control Analyzer (ASCA)** at **MIT**.

John Tukey introduces the term "**BIT**" for binary digit.

1947

The **transistor** is created at **Bell Telephone Laboratories** by **J. Bardeen** and **W.H. Brattain**. It was not used as a viable alternative for the vacuum tube for almost a decade.

The **Association of Computing Machinery (ACM)** is formed.

An invention of **F.C. Williams**, the electrostatic tube, is used for computer memory

1948

IBM produces the **604 Electronic Calculating Punch Machine** and the **607A** Calculating Punch machine.

1949

The **Electronic Delay Storage Computer (EDSAC)** is operational.

The first computer to work in real time, the **BINAC**, is completed and demonstrated.

Iron core memory is used by **Jay Forester** for main computer memory storage.

1950

The **Standards Eastern Automatic Computer (SEAC)** and the **Standards Western Automatic Computer (SWAC)** are completed by the **National Bureau of Standards**.

Jay Raychmen, of **RCA**, applies for a patent for a magnetic memory device.

The **Mark III**, an electronic relay machine, which was commissioned by the United States Naval Proving Ground, is finished.

1951

The **Universal Automatic Computer (UNIVAC)** is the first computer developed for commercial use. This was a first generation computer (first generation computers used vacuum tubes as logic gates) **UNIVAC I** was the 1st digital computer that could work with numerical and alphabetical information.

1952

EDVAC becomes fully operational. Its predecessor, the **ENIAC**, used many more vacuum tubes and had a smaller internal memory.

Harvard Mark IV is completed.

1953

Electrostatic tube memory is introduced in the **ERA 1103** computer.

MIT produces the first successful computer to run a ferrite core main memory.

Zuse develops the **Z5**.

MIT builds an experimental computer - the **TX-0**.

An employee of **IBM**, **Nathaniel Rochester**, develops symbolic assembly program.

1954

Gen Amdahl invents the first operating system.

An experimental electronic calculator which uses transistors is demonstrated by **IBM**.

Harlan Herrick runs the first successful **FORTRAN** program, which was created by John Backus.

The **Transistorized Airborne Digital Computer (TRADIC)** is the 1st universal computer which is entirely transistorized.

Gordon Teal, a physicist with Texas Instruments, perfects a way of making transistors out of inexpensive silicon.

1956

Bell Labs scientists **John Bardeen**, **Walter Brattain**, and **William Shockley**, who invented the **transistor**, share the **Nobel Prize** in physics.

John McCarthy coins the term "**artificial intelligence**."

IBM's 305 **RAMAC**, the first computer with a hard disk drive, is shipped.

1957

John McCarthy developed the **LISP** programming language. This language is said to represent commonsense knowledge and becomes associated with the growing field of **artificial intelligence**.

The first commercial electronic calculator using all solid state circuitry and memory is shipped by **IBM**.

The **first virtual memory machine**, "Atlas," is installed in England.

1958

Jack Kilby invents the integrated circuit. This was a major breakthrough for the electronics industry. It made it possible to produce computer microprocessor chips.

1959

Second generation computers are introduced by IBM. These are computers made with transistors instead of vacuum tubes. This change made it possible to produce smaller, faster and less expensive computers.

The world's first minicomputer is produced by **DEC (Digital Equipment Corporation)**. This was invented by **Benjamin Curley**.

1960

Common Business Oriented Language, better known as **COBOL** is developed.

Model Questions

1. _____ invented the slide rule - a calculating device based on the principle of logarithms. (**William Oughtred**)
2. **Mark I**, This machine performed a _____ at an average (**multiplication and division**)
3. _____ a French mathematician introduces the first digital computer in 1642. (**Blaise Pascal,**)

4. _____ a German mathematician invented a calculating machine which was able to add and perform multiplications. (**Gottfried von Leibnitz,**)
5. _____ introduces **stepped gear** mechanism for addend digits (**Gottfried von Leibnitz**)
6. _____ created the first successful mechanical calculator which could add, subtract, multiply, and divide. (**Thomas of Colmar**)
7. Charles Babbage designed an automatic calculating machine that is called '**Difference Engine**'.
8. Charles Babbage's _____ which was begun in 1823 but never completed. (**Difference Engine**)
9. **Charles Babbage** is called the _____ of the computer. (**Father**)
10. **John Von Neumann**, a mathematician ideas, referred to as _____ (**stored program technique**)
11. Transistors also led to developments in _____ (**computer peripherals**)
12. Name of first disk drive _____ (**A. IBM 350 RAMAC**)
13. The Universal Automatic Computer (UNIVAC), developed in year _____ (**1951**)
14. EDVAC and _____ fell into this group of computers and were the first commercially available computers. (**UNIVAC**)
15. The first processors were _____ (**4-bit**)
16. The _____ was the first popular computer using a single-chip microprocessor. (**Altair 8800**)
17. The _____ was the first PC to be sold as a "laptop". (**Gavilan SC**)
18. The _____ was the first notebook (**Asus Eee PC 700**)

SK. Faiz Ahmed, Nellore.

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