



## History and Evolution of Computers

The earliest known device for calculation is Abacus. With 10 beads strung into the wires attached to a frame, the Abacus used to perform simple calculations. In 1642, Blaise Pascal developed the first basic calculator which would do only limited jobs. In 1690 Leibnitz developed a machine that could perform addition, subtraction, multiplication, division and calculate square roots. However, the instructions were hardcoded into the machine and could not be changed once written.

Charles Babbage in 1822 designed and built a model called difference engine. His invention could perform calculations without human intervention. After that, in 1833, Babbage designed a machine called analytic engine. Technology of the analytic engine provided base to the technology of modern computers. The analytic engine had an arithmetic unit to perform calculations and mechanism to store results and instructions. Because of such contributions Babbage is known as the father of the modern day computers. During late 1940's, Jon Von Neumann found a way to encode instructions in the language. He was the force behind the development of the first stored-program computer.

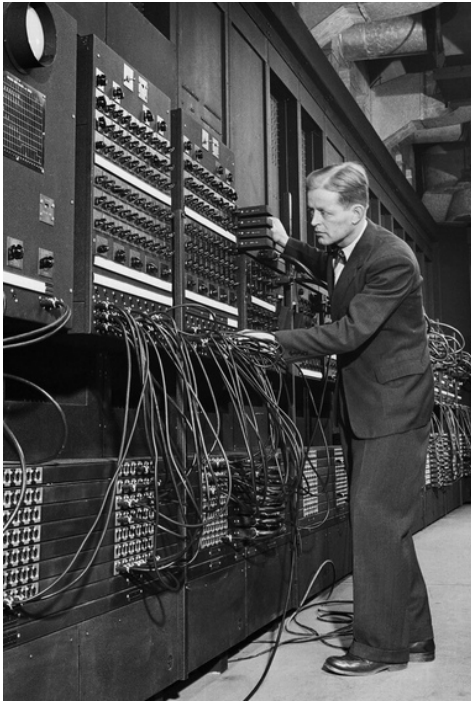
In 1946, J. Presper Eckert and John W. Mauchly invented giant ENIAC machine at the University of Pennsylvania. ENIAC (Electrical Numerical Integrator and Calculator) was the first machine to use large number of vacuum tubes. The machinery required a big space and lot of energy to keep it cool. Further, it had punched-card input and output. The instructions had to be fed into the machine by way of switches because there was no internal memory within the machine. Figure 2.1 shows the ENIAC machine.

### **Generations of Computers Based on Hardware**

Computers may be classified into a number of generations. The classification may be based on the hardware technology used in building a computer or based on its application/software used. First, we will discuss about classification of computer considering various hardware technologies.

#### **First Generation Computers (1945-55)**

The first generation of computers started with ENIAC. It was then followed by the IBM UNIVAC I (Universal Automatic Computer) built by Mauchly and Eckert in 1951. This machine could perform business data processing. The first generation computers used vacuum tubes. Because of vacuum tubes, the first generation computers were very large, required lot of energy, slow in input/output, and suffered with heat and maintenance problems. Further, the vacuum tubes needed to be replaced often as they had short life span. Figure 2.2 shows the vacuum tubes.



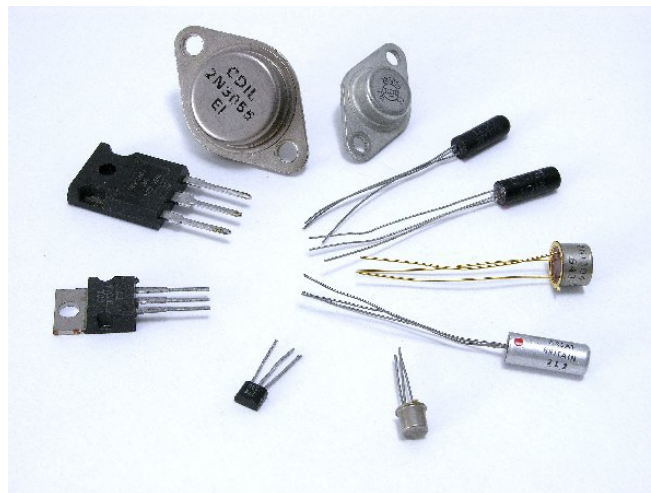
**Figure 2.1 : The ENIAC machine**



**Figure 2.2 : Vacuum tubes**

### **Second Generation Computers (1955-65)**

To overcome difficulties faced in the first generation computers due to the use of vacuum tubes, transistors were used in the second generation computers. Transistor is a small component made of semiconductor material. With transistors, the problem of heat was minimized and computers size was reduced. The computers now could perform operations comparatively faster. The storage capacity was also improved. Instead of working with machine language now the machine could work with higher level languages such as ALGOL and FORTRAN. An example of a second generation computer is IBM 1620. Figure 2.3 shows the transistors.

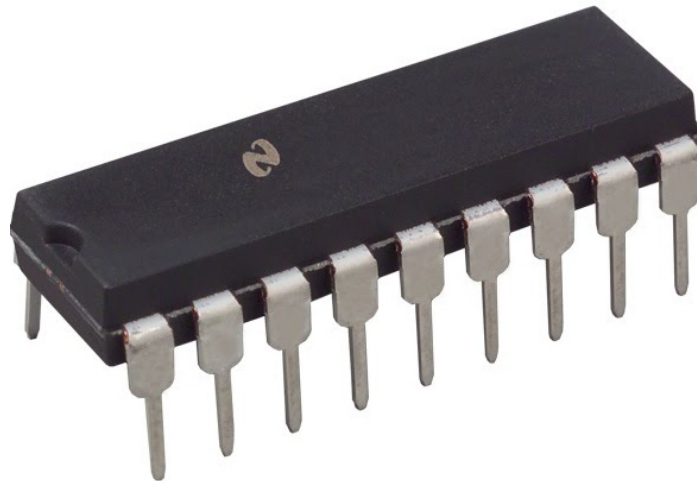


**Figure 2.3 : Transistors**

### **Third Generation Computers (1965-80)**

Third generation computers used Integrated Circuits (ICs) instead of transistors. These circuits are fixed on silicon chip. A silicon chip consumes less than one-eighth of an inch square on which

many electronic components like diodes, transistors, capacitors etc. can be fixed. Figure 2.4 illustrates an integrated circuit on a chip. As the wired interconnections about the circuit components are minimised, these computers were smaller, faster, and more flexible in terms of input and output. Third generation computers satisfy need of a small business. These computers soon became popular as mini computers. Example of third generation computer is IBM 360, PDP 8 and PDP 11 machines.



**Figure 2.4 : Integrated Circuit**

#### **Fourth Generation Computers (1980-89)**

Fourth generation computers used large scale ICs called VLSI (Very Large Scale Integration). Because of this, these computers were faster, smaller, and reliable. The fourth generation computers soon evolved as interactive general purpose machines that allow rapid application development. These generation computers became more user-friendly (easier to use) and can be used widely for personal applications. Hence such machines were called Personal Computers (PCs). Examples are IBM PC and Apple II. The fourth generation computers also include super computers such as CRAY series computers. Super computers are the best in terms of processing capacity and cost. These computers can process billions of instructions per second. They are used for applications which require intensive numerical computations such as stock analysis, weather forecasting and other similar complex applications. The spread of computer network was also observed during this time period.

#### **Fifth Generation Computers (1989-till date)**

Fifth generation computers are further made smarter in terms of processing speed, user friendliness and connectivity to network. These computers are portable and sophisticated. Powerful desktops, notebooks, variety of storage mechanism such as optical disks, and advanced software technology such as distributed operating system and artificial intelligence are key features of the fifth generation computers. IBM notebooks, Pentium PCs and PARAM 10000 are example of the fifth generation computers.

Table 2.1 enlists important characteristics of different computer generations.

Generation	Characteristics	Examples
First	Used Vacuum tubes Bigger, slower and less efficient Used punch cards Not commercially used	IBM UNIVAC I
Second	Used Transistors Faster and smaller than previous generation Worked with higher level languages	IBM 1620
Third	Used Integrated circuits Flexible and smaller Well suited for commercial applications Known as mini computers	IBM 360 PDP 8 PDP 11
Fourth	Used Very Large Scale Integrated Circuits (VLSI) Interactive general purpose machines Allow rapid application development Easier to use for personal application Can be easily used in network	IBM PC Apple II Super computers such as CRAY series computers
Fifth	Portable and sophisticated Superior in processing speed, user friendliness and Connectivity to network Supports artificial intelligent techniques	IBM notebook Pentium PCs PARAM 10000

**Table 2.1 : Computer Generations and Their Characteristics**

### Generations of Computers Based on Software

Just like five hardware generations, there are software generations too! The very **first generation** is machine level language or machine language, which is a two state language having symbols 0 and 1. This is also called binary language. Computer being mainly an electronic device understands this language.

To avoid difficulties working with the machine level language, assembly language was introduced. Assembly Language uses ‘mnemonic codes’ or ‘symbols’. The assembly language is considered as **second generation** computer language.

Whether it is a machine language or assembly language, it was still tedious to provide data and instructions. We are more comfortable with English like language. It would be much more comfortable if the data and instructions can be provided to computers in English like higher level language (or subset of English language) and computers can be trained to translate it into machine readable form. Taking this idea as an inspiration, the **third generation** languages as a subset of English language



were designed. These third generation languages are also known as higher level languages. To make machine automatically translate the content written in higher level language, special utility called **translator** (such as compiler and interpreter) is used. The translator written in machine understandable form converts data and instructions provided into the English like higher level language into machine understandable form. Examples of such higher level languages are C, COBOL, and Java programming languages.

After exploration of such third generation programming languages, more sophisticated programming environments called fourth generation languages are introduced. The **fourth generation** programming languages reduce programming effort by just specifying what to do instead of how to do. Structured Query Language (SQL) is an example of the fourth generation programming language.

While fourth generation programming languages are designed to quickly develop applications by specifying only what to do, **fifth generation** languages are designed to make the computer solve a given problem without the programmer. Some examples of applications that require such support is fault finding, voice recognition and intrusion detection. Such tasks are carried out in transparent fashion from users in order to avoid complexity and to facilitate user friendly interactions with the systems. Fifth generation programming languages use artificial intelligence techniques to meet their goal. The Artificial Intelligence (AI) techniques can handle imprecision and supports human like self learning and problem solving. These characteristics help putting the AI based applications a step ahead with added intelligence in comparison with the application developed in other programming languages or tools.

## Types of Software

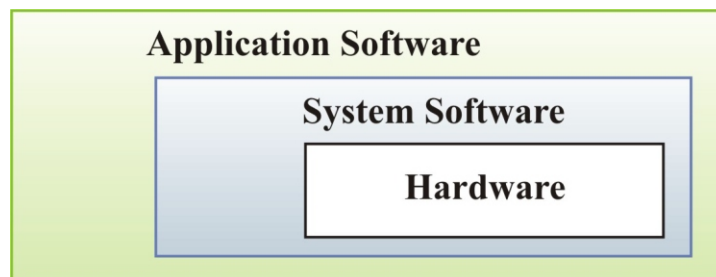
As we have seen, software plays a vital role in computer systems by creating a bridge between the computer hardware and computer users. Computer software can be considered as soul of computer, without which computer cannot work. Software is organized collection of data and instructions given to computers in order to perform a given task. We have seen some components of computer software in figure 1.4 of chapter 1. These components are data, instructions and documents about the software (written description of software functions) such as comments. The set of instruction is also called computer program. The process of writing (or coding) programs is called programming, and individuals who perform this task are called programmers.

There are two major types of software: systems software and application software. **Systems software** manages computer hardware and act as an interface between computer hardware and software developed for business application. Systems software provides important functionalities like booting computers properly, managing memory, channeling data from secondary memory to primary memory, managing printers and other resources. Example of system software is an operating system. The translator programs mentioned in this chapter are also examples of system software. Some translator programs transform whole source code written in a programming language (the source language) into another computer language (the target language, mainly machine/binary language) at once. The transformed (translated) code is later executed to obtain the desired results. These programs are called **compilers**. Some translator programs transform the source code into the target code in line by line fashion and produce the result simultaneously. These programs are called **interpreters**. Since

interpreters try to convert the source program line by line, they can concentrate on a single line, hence it is not possible to analyze the source code fully. Further, the interpreters are generally slow in comparison with the compilers.

Computer also support business applications such as printing reports from data stored, calculating bills, generating pay-slips, marking attendance, printing students' mark-sheets, etc. Special software need to be developed for this type of application specific support. Such software is known as **application software**. Application software is a set of computer instructions that provide application specific functionalities to a user. These functionalities may be general purpose such as word processing (that every business need) or may be very narrow, such as an organization's payroll program that generates pay-slips in company's format, on company's preprinted stationery.

The relationship among hardware, systems software, and application software is illustrated in figure 2.5.



**Figure 2.5 : Relationship Amongst Various Components**

### Popular Computers

So far we have discussed that the computers operate on binary digits 0 and 1. Even if the instructions are given in any generation programming language, ultimately they are to be represented into sequence of digits 0's and 1's. Hence, the computers are also known as **digital computers**. Analog computers use linear combinations of voltage amplitude (or currents or frequencies or phases) instead of digits. That is why they are called **analog computers**. Some computers use mixture of these technologies and hence known as hybrid computers.

### Personal or Desktop Computers

These computers are the most popular computer systems. They are easier to use and more affordable. They are normally used by individuals for their routine business activities. Figure 2.6 shows a sample desktop computer. Desktop computer is used for regular computing operation from a specified place such as an office. Modern desktop are accompanied with monitor, key board and a mouse along with a system box.



**Figure 2.6 : Desktop Computer**

## Laptop Computers

Laptop computers are portable and lightweight computers with a thin screen. They are also called **notebook** computers because of their small size. They can operate on batteries and hence are very popular with travelers. Figure 2.7 shows a typical laptop computer. A laptop computer is actually a personal computer for mobile use. A laptop has most of the same components as a desktop computer, including a display, a keyboard, a pointing device such as a touchpad (also known as a trackpad) and/or a pointing stick, and speakers into a single unit. Now a day's thin version of laptop called ultrabook is becoming popular. The ultrabook size and weights are thinner in comparison with the typical laptops. Ultrabook computing technology use high-powered low-voltage processors with long battery life. Figure 2.8 shows a typical ultrabook.



**Figure 2.7 : Laptop**



**Figure 2.8 : Ultrabook**

## Handheld Computers

Handheld computers are also known as Personal Digital Assistants (PDAs). They are small in comparison with laptop and can be carried anywhere. They use a pen like stylus and accept handwritten input directly on the screen. The screen is generally a touch screen. They are useful in applications like scheduling appointments, storing contacts and addresses and playing games. Figure 2.9 shows a typical handheld computer.



**Figure 2.9 : Handheld Computer**

## Tablet Computer

A tablet computer is a portable and mobile computing tool. It is a mobile computer like a bigger mobile phone with a touch screen facility. It generally uses onscreen virtual keyboard, a passive stylus pen, or a digital pen. Typically, such tablet computers do not require keyboard. There are two popular categories of the tablet PCs. These categories are (i) a slate tablet PC and (ii) a convertible tablet PC. The slate tablet is a type of tablet where keyboard is not attached. However, on demand, the keyboard can be added. A convertible tablet PC is basically a laptop computer with a screen that can swivel and fold onto the keyboard to create the tablet. Figure 2.10 shows a typical tablet computer.



**Figure 2.10 : Tablet Computer**

## Wearable Computers

Wearable computers are also known as body-borne computers. These are tiny computing devices that are worn by the bearer. The wearable computers are small and light weight as they need to be carried on human body. The wearable computers come in the form of bracelet, pendent, spectacles and rings. Wearing such devices enables constant interaction with the computing system. There is less need to turn the device on or off. Further, such devices are multi-tasking. You may do other routine job in parallel. Often such device is considered as an extension of the user's mind and/or body. Variation of wearable computers such as a small programmed chip, is used for monitoring animal movement. A pre-programmed light weight micro-processor chip is stapled on animal's body part like ears. Such a chip monitors movement of animal in a given region.

### Summary

In this chapter we have discussed the history and evolution of computers. We have considered two aspects namely hardware generations and software generations. We have provided brief discussion on their components and technologies. We further learnt about different types of software such as system software and application software. Finally we saw popular computing machines such as desktop, laptop and tablet computers along with wearable devices.

### EXERCISE

1. Write a short note on history of computers. Also explain why Charles Babbage is known as the father of the modern day computers.
2. Discuss characteristics of the first generation computers. What are the major drawbacks of these computers ?
3. Discuss characteristics of the second generation computers. What are the major drawbacks of these computers ?
4. What is machine level language ?
5. What is an assembly language ?
6. What are the difficulties associated with the machine level and assembly languages ?



7. Define higher level languages. Also provide two examples of higher level languages.
8. What are translators ? In which language the translators should be written ?
9. What is fourth generation language ? Give an example of it.
10. What is system software ?
11. What is application software ?
12. Distinguish system software and application software.
13. Write a short note on modern/popular computers.
14. Define the terms :
  - (a) Digital computer
  - (b) Analog computer
  - (c) Hybrid computer
  - (d) Notebook computer
  - (e) Personal digital assistants
15. Write a short note on wearable computers.
16. **Choose the most appropriate option from those given below :**
  - (1) Which of the following is known as father of modern day computers ?
    - (a) Charles Babbage
    - (b) Blaise Pascal
    - (c) Jon Von Neumann
    - (d) Jon Von Pascal
  - (2) Which of the following is full form of ENIAC ?
    - (a) Electrical Number Integrator and Converter
    - (b) Electrical Numerical Integrator and Calculator
    - (c) Electrical Numerical Inverter and Calculator
    - (d) Electrical Number Inverter and Converter
  - (3) Which of the following are bulky, slow and suffered with heat and maintenance problems ?
    - (a) Transistors
    - (b) Radios
    - (c) Vacuum tubes
    - (d) Integrated circuits
  - (4) Third generation computers used which of the following technologies ?
    - (a) Transistors
    - (b) Integrated circuits
    - (c) Vacuum tubes
    - (d) Very large Integrated circuits
  - (5) Which of the following computers are the costly and can process billions of instructions per second ?
    - (a) Super computers
    - (b) Laptop computers
    - (c) Hybrid computers
    - (d) Any of these
  - (6) In which of the programming language mnemonic codes are used ?
    - (a) Assembly
    - (b) Higher level
    - (c) Machine level
    - (d) User level

- (7) Java, C and COBOL are examples of which of the levels of languages ?
- (a) Assembly
  - (b) Higher level
  - (c) Machine level
  - (d) User level
- (8) Which of the following generations of programming languages reduce programming effort by just specifying what to do instead of how to do ?
- (a) First
  - (b) Second
  - (c) Third
  - (d) Fourth
- (9) Which of the following language generations use artificial intelligence techniques for problem solving and meeting their goal ?
- (a) Second
  - (b) Third
  - (c) Fourth
  - (d) Fifth
- (10) Operating system is an example of which of the following type of software.
- (a) Applications
  - (b) System
  - (c) Business
  - (d) User created
- (11) In which category of the software does the payroll application fit ?
- (a) Applications
  - (b) System
  - (c) Control
  - (d) Any of these
- (12) Which of the following software manage computer hardware and act as an interface between computer hardware and software developed for business application ?
- (a) Applications
  - (b) System
  - (c) Control
  - (d) Any of these
- (13) What do you call a computer that operates on binary digits 0 and 1 ?
- (a) Digital
  - (b) Analog
  - (c) Hybrid
  - (d) Any of these
- (14) What do you call a computer that uses linear combinations of voltage amplitude (or currents or frequencies or phases) instead of digits ?
- (a) Digital
  - (b) Analog
  - (c) Hybrid
  - (d) Any of these
- (15) Which of the following is also referred to as a handheld computer ?
- (a) Portable Digital Assistants (PDAs)
  - (b) Personal Digital Assistants (PDAs).
  - (c) Personal Digital Applications (PDAs)
  - (d) All of these

